
**“SUPRAPUBIC VS UMBILICAL PORT FOR
VISUALIZATION OF APPENDIX IN LAPAROSCOPIC
APPENDECTOMY AND TO DETERMINE THE
EASINESS OF SURGERY: ONE YEAR
PROSPECTIVE CROSS- SECTIONAL STUDY”**

**BY
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LIST OF ABBREVIATIONS

LA	:	Laparoscopic appendectomy
OA	:	Open appendectomy
GALT	:	Gut associated lymphoid tissue
PT/ INR	:	Prothrombin time / International normalized ratio
CT	:	Computed Tomography
USG	:	Ultrasonography
OT	:	Operation theatre
SILS	:	Single incision laparoscopic surgery
SPLS	:	Single port laparoscopic surgery
Endo-GIA stapler	:	Gastrointestinal anastomosis stapler
SILA	:	Single incision laparoscopic appendectomy
TLA	:	Three laparoscopic appendectomies
SSIs	:	Surgical Site Infections

ABSTRACT

Background: Appendicitis is a frequently encountered surgical emergency. Appendicitis presents a significant healthcare burden globally. The study aims to compare suprapubic vs umbilical port in visualization of appendix and to determine the easiness of surgery in laparoscopic appendectomy.

Methods: A prospective cross-sectional study was conducted with 60 patients divided into two groups. Group A underwent laparoscopic appendectomy using umbilical camera port, while Group B underwent laparoscopic appendectomy using suprapubic camera port. Data on Age, gender, position of appendix, time taken for visualization of appendix from the start of surgery, visualization of ileocecal junction, easiness to trace the bowel, ease of dissection and operative time of surgery were collected and analysed.

Results: Time taken for visualization of appendix from the start of surgery was lesser in the Group B when the position of appendix was retrocaecal and sub caecal while was lesser in the Group A when the position of appendix was pelvic and pre-ileal.

Ease of dissection was better in the suprapubic camera port due to better visualization of appendix as the majority were retrocaecal in position. Operative time of surgery was significantly lower in Group B (58.3 minutes) compared to Group A (65.6 minutes).

No significant difference in the visualization of ileocecal junction, easiness to trace the bowel between both the groups although preferably suprapubic camera port was better.

Conclusion: The use of suprapubic camera port yielded better results in visualization of the position of the appendix and the easiness of surgery compared to the umbilical camera port and the conventional techniques used worldwide.

Keywords: Appendicitis, laparoscopic appendectomy, suprapubic camera port, umbilical camera port

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INTRODUCTION

Appendicitis is a frequently encountered surgical emergency ^[1,2]. Since McBurney's publication in 1894, appendectomy has become the established standard procedure for treating appendicitis and is most common surgical procedure performed in emergencies worldwide ^[3].

Laparoscopic appendectomy (LA), introduced in the early 1980s, is linked to shorter hospital stays and reduced complication rates compared to open appendectomy for uncomplicated appendicitis ^[4,5]. These advantages extend to high-risk patient groups such as the obese, elderly, and those with medical conditions, as well as in low and middle Human Development Index Country (LMHDC) populations ^[6]. Consequently, several surgical societies now advocate for LA as the primary treatment option for uncomplicated appendicitis. ^[4,5,7].

With the introduction of laparoscopic appendectomy (LA) by a German Gynaecologist, Kurt Semm ^[8] in 1983, a long controversy had begun. Several studies have been made comparing open appendectomy (OA) with LA. ^[9] In a review of more than 30,000 appendectomies in patients older than 16 years old, Ingraham et al. (2010) demonstrated that laparoscopy was associated with a lower overall morbidity, lower serious morbidity, less surgical site infection and shorter postoperative stay. ^[10]

The popularity of LA has increased since its conception but it is still far from attaining the status of “Gold Standard”. The advantages of LA are more accurate diagnosis, quicker and less painful recovery, reduced incidence of wound infections, ability to treat obese patients effectively, and faster recovery time, fewer complications, superior cosmetic and better assessment of other intra-abdominal

pathologies. Different techniques have been described by different authors for LA in respect to port placement, handling the base of appendix, division of mesoappendix and removal of appendix. ^[11-18] Either periumbilical or supra pubic camera port has been used for placement of laparoscope. The location for the working ports also varies from right upper quadrant to Mc Burney's point, lower midline and left iliac fossa in standard surgical and laparoscopic texts. ^[19-21]

Early randomized trials often did not demonstrate clear overall benefits for laparoscopy in appendectomy. The increased operative duration, comparable hospital stays, and heightened risk of intra-abdominal collections or postoperative ileus associated with laparoscopic appendectomy (LA) were perceived to outweigh any improvements in wound complications, recovery times, or cosmetic outcomes. However, recent studies suggest a shift towards favouring laparoscopy, likely influenced by increased exposure to laparoscopic techniques across various surgical training levels. These studies present evidence of reduced operative times, faster recovery rates, and lower rates of wound complications, along with a reversal in the risk of developing ileus, which now favours laparoscopy. ^[22]

Suprapubic camera port placement provides superior visualization of the inferior surface of the caecum, the appendiceal base, and the lateral part of the caecum as in the umbilical camera port visualizes the medial part of caecum and the paracolic gutter and as most of the appendix is positioned in retrocaecal, the suprapubic camera port is superior to the umbilical camera port. A 10-mm umbilical port for laparoscope and for extraction of appendix and two 5-mm as working port in supra pubic area below the pubic hair line are used. The most commonly performed laparoscopic surgery by general surgeons is appendectomy, this technique has an advantage that

the functional three ports are moved one quadrant down, i.e. laparoscope from umbilicus to suprapubic, right hand working port from epigastrium to umbilicus and left-hand working port from right hypochondrium to right iliac fossa, and thus the team and theatre setup essentially remains unchanged. [23,24]

Several surgical societies now advocate for laparoscopic appendectomy (LA) as the preferred initial treatment for uncomplicated appendicitis. However, there is still ongoing debate and variability in consensus regarding the sequence and execution of crucial technical steps aimed at optimizing clinical outcomes and minimizing resource utilization during LA. There are a lot of anecdotal studies on results and of different approaches for laparoscopic appendectomy, in world literature, but there are very few published large Indian studies, analysing the result of suprapubic camera approach for laparoscopic appendectomy, in Indian patients and comparing it with other available approaches to find its efficacy and accuracy.

In advent of same, we planned this prospective study to compare suprapubic camera port versus umbilical camera port for visualization of appendix and ease of surgery in laparoscopic appendectomy.

AIMS & OBJECTIVES

To compare suprapubic vs umbilical camera port for visualization of appendix in laparoscopic appendectomy and to determine the easiness of surgery.

1. To visualize the position of appendix
2. To determine the Ease of surgery

REVIEW OF LITERATURE

APPENDICEAL DISEASE

Historical background [25]

Appendicitis is a common reason for emergency hospital admission, and appendectomy is one of the most common emergency procedures performed worldwide.

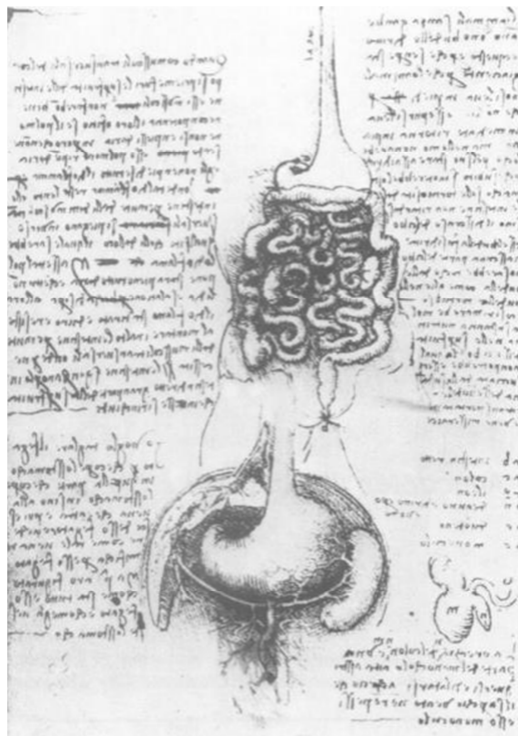


Fig 1. Drawing by Leonardo da Vinci showing the appendix (1492)

In 1492, Leonardo da Vinci studied the internal organs and was the first one to draw human appendix but these were not published until the eighteenth century, and was well illustrated in the Andreas Vesalius work, "De Humani Corporis Fabrica," published in 1543. [26]

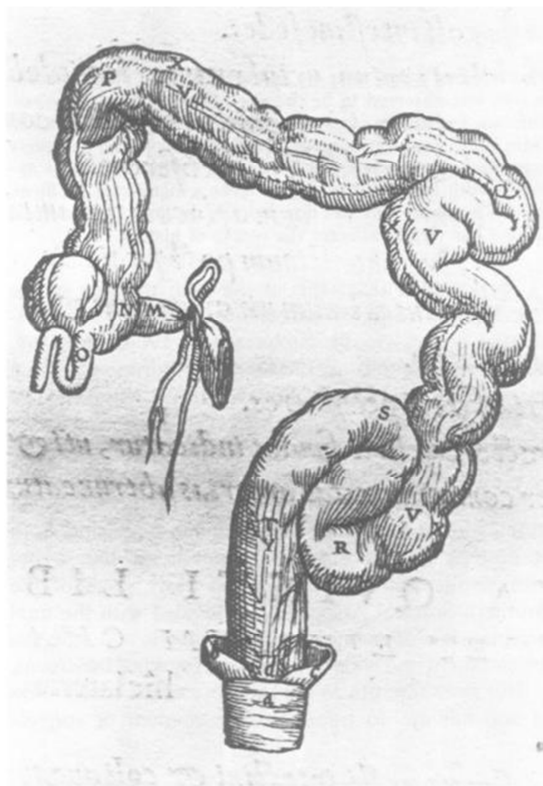


Fig. 2. Andreas Vesalius "De Humani Corporis Fabrica" 1543

Jean Fernel first described appendiceal disease in a paper published in 1544.

The first description of classic appendicitis was given by Lorenz Heister in 1711.

Claudius Amyand performed the first known appendectomy in 1736 in London. In 1886, Reginald H. Fitz presented the findings of appendicitis and recommended operative treatment. Charles McBurney published the indications for early laparotomy in appendicitis in 1889. ^[25]

Embryology

During the sixth week of intrauterine development, a small diverticulum emerges on the caudal end of the midgut loop. Over time, this diverticulum undergoes differentiation, ultimately forming the caecum and the vermiform appendix. Until the

fifth month of fetal development, the diverticulum exhibits a conical shape. However, as development progresses, its distal part remains underdeveloped and evolves into the vermiform appendix, while its proximal part enlarges to become the caecum. By the time of birth, the vermiform appendix extends from the apex of the caecum. Due to unequal growth of the caecal walls, the appendix subsequently shifts to lie on the medial side of the caecum after birth. This developmental process explains the anatomical positioning and formation of the appendix relative to the caecum during fetal and neonatal stages. In certain conditions like midgut malrotation and situs inversus, the caecum (and thus the appendix) will not be in the right iliac fossa. In midgut malrotation appendix lies in the left hypochondrium whereas in situs inversus appendix lies in the left iliac fossa.

Anatomy

The vermiform appendix is a slender, worm-shaped tube that originates from the posteromedial wall of the caecum, typically located about 2 cm or less below the junction with the end of the ileum. In adult average measurement of the appendix is 6 to 9cm, however it can vary from 1 to 30 cm. The outer diameter varies from 3 to 8 mm, and luminal diameter from 1 to 3 mm. It is longer in children than in adults. Its position may vary and is named according to its positions.

Positions:

- I. Retrocaecal/Retrocolic - 74%
- II. Pelvic - 21%
- III. Subcaecal - 1.5%
- IV. Preileal - 1%
- V. Postileal - 0.5%

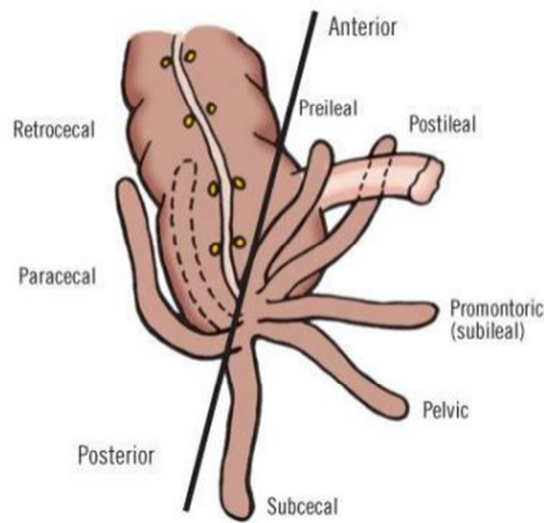


Fig 3. Anatomy of Appendix

The base of the appendix is commonly marked on the surface by the junction of the lateral and middle thirds of a line drawn between the right anterior superior iliac spine and the umbilicus, which is known as McBurney's point. At this point, the three taeniae coli of the ascending colon and caecum converge and merge into the longitudinal muscle layer of the appendix. This anatomical feature helps to locate and identify the base of the appendix during surgical procedures or clinical examinations. The anterior taeniae (Taeniae libra) of the caecum, which is generally distinct and can be easily traced to the root of the appendix, is used as a guide.

The appendix is connected by a short mesoappendix to the below part of the mesentery of the ileum. Mesoappendix contains the main appendicular artery, which is a branch of the lower division of ileo-colic artery. This arterial supply of the appendix may vary considerably. Accessory arteries are common. In 80 % of subjects there are two or more accessory arteries. This is known as Dr. Seshachalam's artery. This has got applied importance during appendicectomy.

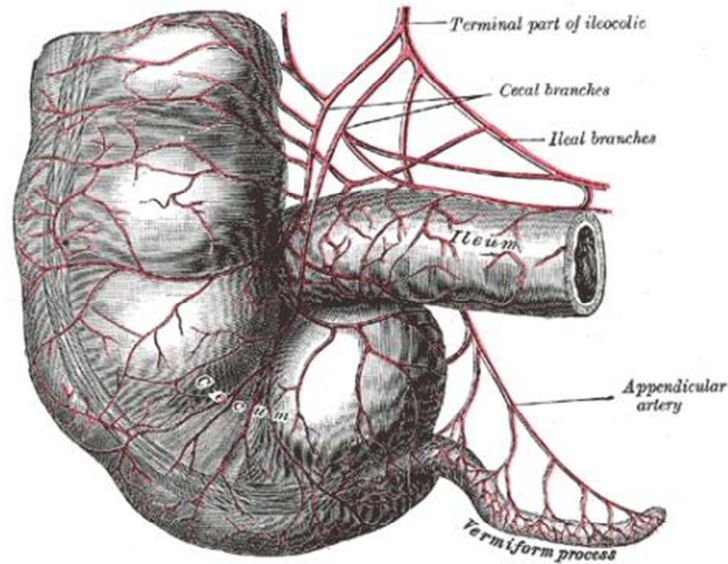


Fig 4. Arterial supply to Appendix

Anatomical considerations concerned to appendicitis:

Appendix is a susceptible site for inflammation and infection because

- It is long tube like organ, with a narrow lumen
- It is cul-de -sac (one end is blind)
- Rich in lymphoid tissue (known as abdominal tonsil)
- Positional variations
- Has got false valve of Gerlach
- Appendicular artery is an end artery
- Near to caecum, which is rich in all microorganisms

Microscopic anatomy:

The lumen of the appendix is irregular, being encroached upon by multiple longitudinal folds of mucous membrane lined by columnar cell intestinal mucosa of colonic type. Crypts are present but are not numerous. In the base of the crypts lie the argentaffin cells (Kulchitsky cells) which may give rise to carcinoid tumours. The submucosa contains numerous lymphatic aggregations of follicles.

Venous drainage:

Drained by branches of the ileocolic vein which drain the appendiceal venous network which further goes to superior mesenteric vein which in turn empties into the portal system

Lymphatic drainage:

Lymphatic vessels pass to the lymph nodes in the mesentery of the appendix and those that lie along the ileocolic artery.

Nerve supply:

Nerves are derived from the vagus (parasympathetic nerves) and from superior mesenteric ganglia and celiac ganglia (sympathetic nerves). The nerves are distributed in plexus around ramification of superior mesenteric artery.

Histology

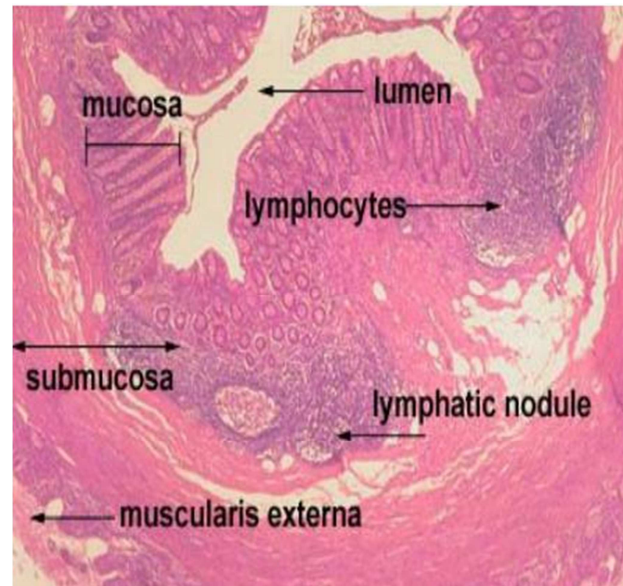


Fig 5. Histology of Appendix

Physiology

It was thought that appendix is a vestigial organ with no function. It is proved that appendix functions as an immunologic organ and secrete immunoglobulins, especially immunoglobulin-A. Secretory immunoglobulins produced by Gut associated lymphoid tissue (GALT) function as a very effective barrier that protects milieu interior against the hostile milieu exterior.

Removal of the appendix produces no detectable change in human function. Patients who undergo appendectomy before the age of 20 years have less chance of developing ulcerative colitis.

Pathophysiology

The prevailing theory regarding the development of appendicitis suggests that it typically arises from obstruction followed by infection. Obstruction occurs when the lumen of the appendix becomes blocked due to various factors such as hyperplasia of submucosal lymphoid follicles, the presence of a faecolith (hardened stool), a tumor, or other pathological conditions. This obstruction leads to increased pressure within the appendix, impairing its blood flow and promoting bacterial overgrowth and infection. In acute appendicitis faecoliths and calculi are found in 40 % of patients. In gangrenous appendicitis without rupture and in gangrenous appendicitis with rupture, faecoliths and calculi are found in 65 % and 90 % respectively.

Once the lumen of the appendix becomes obstructed, the sequence of events leading to acute appendicitis unfolds as follows:

- Mucus accumulates within the appendix lumen, causing an increase in internal pressure.
- Virulent bacteria transform the accumulated mucus into pus.
- The ongoing secretions, coupled with the relatively rigid nature of the serosa, further elevates the pressure within the appendix.
- This pressure rise obstructs lymphatic drainage, leading to appendix swelling, bacterial migration through the tissue, and the development of mucosal ulcers.
- During this stage, the disease remains confined to the appendix, causing visceral pain localized to the epigastrium or periumbilical region.
- Continued mucus secretions and increasing swelling exacerbate intraluminal and tissue pressures, resulting in venous blockage and appendix tissue ischemia.

- Bacteria infiltrate and traverse the appendix wall, initiating acute suppurative appendicitis.
- Somatic pain emerges when the inflamed appendix serosa contacts the parietal peritoneum, causing classic pain relocating to the right lower quadrant.
- As the condition progresses, venous and arterial thromboses arise in the appendix wall, leading to gangrenous appendicitis. At this stage, small infarctions occur, allowing bacteria to escape and contaminate the peritoneal cavity.
- The final stage involves perforation through a gangrenous infarct, resulting in the release of accumulated pus. Perforated appendicitis is established, significantly increasing morbidity and mortality rates.

ACUTE APPENDICITIS ^[27,28]

Acute appendicitis represents a significant portion of abdominal emergencies, constituting approximately 1% of all surgical operations. While rare in infants, its incidence rises steadily throughout childhood, peaking between the ages of 10 and 30 years. Although less common after the age of 30, appendicitis can affect individuals of any age.

Among teenagers and young adults, there is a male-to-female ratio of about 3:2. This ratio gradually decreases after the age of 25, becoming equal by the mid-30s. Therefore, while appendicitis predominantly affects younger populations, it remains a potential concern across all age groups. ^[29]

Microbiology

The microbial composition of an inflamed appendix differs significantly from that of a normal appendix. In approximately 60% of cases with inflamed appendices, anaerobic microbes are found in aspirates, compared to only 25% in normal appendices. Tissue cultures from inflamed appendix walls commonly reveal the presence of *Escherichia coli* and *Bacteroides* species. Additionally, microbes not typically part of the normal caecal flora, such as *Fusobacterium nucleatum/necrophorum*, are identified in about 62% of inflamed appendices. Alongside more common microbes like *Peptostreptococcus*, *Pseudomonas*, *Bacteroides splanchnicus*, *Bacteroides intermedius*, and *Lactobacillus*, previously unknown fastidious gram-negative anaerobic bacilli have also been detected. *Bacteroides* have been observed to invade tissue, particularly in cases of gangrenous or perforated appendicitis ^[30].

Clinical diagnosis of acute appendicitis relies heavily on the application of clinical skills by the surgeon. Diagnosis typically begins with a thorough patient history, often starting with abdominal pain localized to the epigastrium or periumbilical area, accompanied by symptoms such as anorexia, nausea, and vomiting. Typically, after an initial period, usually around 8 hours, the pain shifts to the right side, specifically the right lower quadrant of the abdomen.

Murphy's syndrome(triad)-

1. Right lower quadrant pain
2. Fever
3. Vomiting

Clinical outcome for appendicitis

1. Resolution
2. Gangrenous appendicitis
3. Perforation leading to generalized peritonitis
4. Appendicular mass or abscess formation
5. Fibrosis

COMPLICATIONS OF ACUTE APPENDICITIS

- I. Perforation and its consequences
- II. Abscess formation and its complications
 - a. Appendico- cutaneous fistula
 - b. Appendico vesical fistula
- III. Diffuse peritonitis
 - Due to contamination of peritoneal cavity before defensive adhesion formation
 - Secondary rupture of intra-abdominal abscesses that were produced by ruptured appendicitis.

Treatment

Patients diagnosed with acute, non-perforated appendicitis typically require urgent appendicectomy. While there have been limited studies exploring the use of antibiotic therapy alone for appendicitis, Erikson and Granstrom conducted a randomized trial comparing antibiotic therapy versus surgical treatment. They found initial success rates of 85%, but with a high recurrence rate of 35% in a short follow-up period. Due to this high recurrence rate, surgical treatment remains the current standard of care. The definitive treatment for acute appendicitis and its complications

is surgery, with the primary consideration being the timing of surgical intervention. There is a difference of opinion concerning the optimal timing for ruptured appendicitis with frank peri appendiceal abscess formation. Expectant treatment was advocated by A.T. OCSHNER in 1901. If progression occurs, the abscess is drained. If the patient improves, conservative treatment is continued. With these measures, the majority of appendiceal abscesses resolve satisfactorily, although many days of hospitalization is required.^[31] An interval appendectomy 6 weeks to 3 months later is strongly advised, since the recurrence rate is very high.^[32]

LAPAROSCOPIC APPENDECTOMY

Background

Appendicitis is a prevalent cause of surgical abdomen. In 1894, McBurney established the open appendectomy technique, which became the standard treatment for acute appendicitis^[33]. However, the introduction of laparoscopic appendectomy in 1980 by Kurt Semm, a Swiss gynaecologist, marked a significant advancement^[8].

Laparoscopic appendectomy offers several advantages over open surgery, including reduced postoperative pain, quicker recovery, lower wound infection rates, and decreased incidence of adhesions. Complication rates are comparable between laparoscopic and open approaches. Laparoscopic appendectomy is safe even in cases of perforated appendicitis, contingent upon the surgeon's proficiency. It provides superior intraoperative cleanliness and direct visualization during peritoneal irrigation.

Additionally, laparoscopy enables comprehensive exploration of the abdominal cavity to exclude other pathologies and manage them concurrently. Its cosmetic benefits are particularly appreciated in women. The widespread adoption of laparoscopic and minimally invasive techniques in general surgery has made diagnostic laparoscopy and laparoscopic appendectomy standard procedures for many surgeons ^[34].

Early use of diagnostic laparoscopy in patients with suspected appendicitis and right lower quadrant pain reduces the risk of appendiceal perforation and negative appendectomy rates to less than 10% ^[35]. This approach is especially valuable in reproductive-age women and obese patients, where it aids in diagnosing confounding gynaecologic conditions and allows for conservative management when the appendix appears normal. Conversion from diagnostic to therapeutic laparoscopy is straightforward by adding additional ports. ^[36]

The placement of trocars for laparoscopic appendectomy varies among surgeons, typically following the triangle rule. Diagnostic laparoscopy typically utilizes a periumbilical port, with a 10/11-mm port added midway between the umbilicus and pubis, and a 5-mm port positioned over the suprapubic and other 5mm port either in the left iliac fossa or right mid-lateral abdomen if appendectomy is required ^[37].

Once the diagnosis is confirmed, the mesoappendix can be dissected using hemoclips or a harmonic scalpel. The appendix is then either ligated with endoloops or removed with an endo-GIA stapler from the caecum. Extraction of the appendix from the abdomen can be performed using a specimen pouch or through the 10/11-

mm port, with precautions taken to prevent contamination of the wound edges by the appendix or its contents.

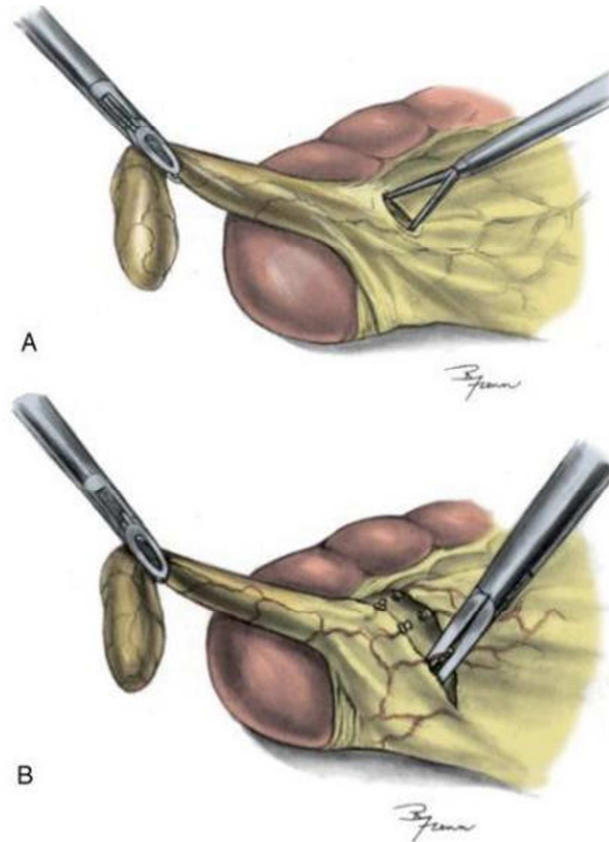


Fig. 6: Technique for Laparoscopic Appendectomy^[38]

A. The appendix is grasped and retracted towards the pelvis to expose the mesoappendix.

B. The mesoappendix is divided using individually placed clips or various energy sources.

Other relative contraindications to laparoscopic appendectomy include previous abdominal surgeries that prevent safe trocar placement, uncontrolled coagulopathy, and significant portal hypertension.

Laparoscopic appendectomy has demonstrated safety and efficacy. It facilitates rapid diagnosis and significantly reduces the rate of unnecessary appendectomies in women of childbearing age with suspected appendicitis. Minimal access surgery also lowers the morbidity risk in obese patients requiring appendectomy [38-42].

****Indications: ****

- Any patient presenting with signs and symptoms of appendicitis.

****Contraindications: ****

- Patients with severe sepsis and generalized peritonitis.
- Severe pulmonary disease where carbon dioxide pneumoperitoneum may worsen their condition.
- Hemodynamically unstable patients.
- Coagulopathy with elevated PT/INR.
- Advanced pregnancy where intra-abdominal working space is inadequate.

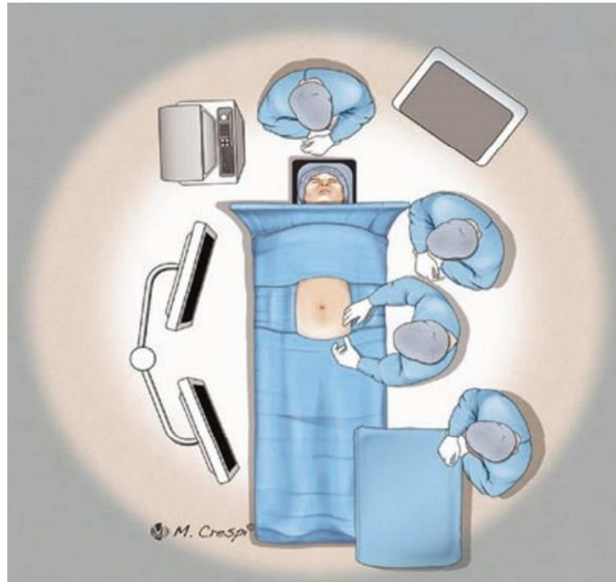


Fig 7: OT Setup

****Surgical Technique****

****Conventional Technique with Umbilical Camera Port****

1. ****Anaesthesia Induction: ****

- The patient is placed under general anaesthesia to ensure comfort and immobility during the procedure.

2. ****Port Insertion and Pneumoperitoneum: ****

- A 10 mm port is inserted at the umbilicus using Hasson's technique, which involves making a small incision and carefully creating a seal to prevent gas leakage.
- Pneumoperitoneum is established by insufflating carbon dioxide (CO₂) into the abdominal cavity at a pressure of 12 mmHg and a flow rate of 20 L/min. This creates a space for the laparoscopic instruments and camera.

3. ****Additional Trocar Placement: ****

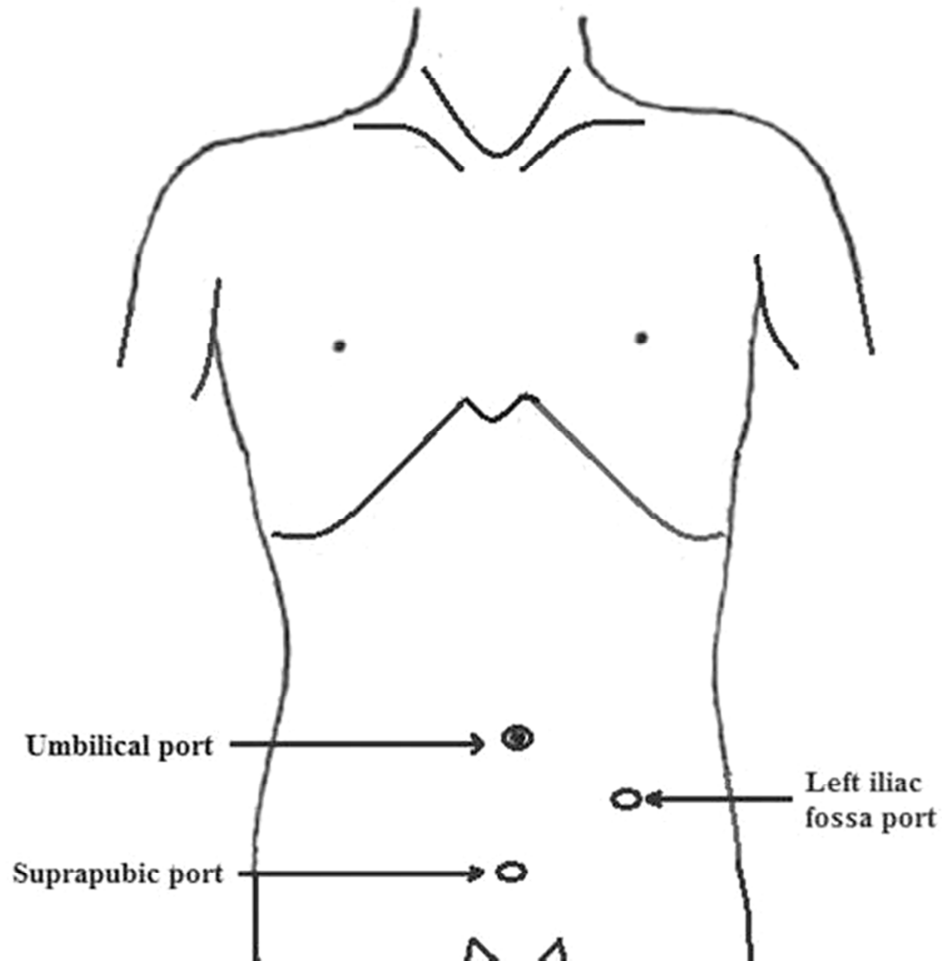
- A 5 mm port is subsequently placed in the left lower quadrant to facilitate manipulation and instrument insertion.
- Another 5 mm trocar is inserted at the suprapubic area under direct vision to minimize the risk of injury to intra-abdominal organs and vessels.
- In female patients, the right upper quadrant trocar may be repositioned below the bikini line for better access.

4. ****Diagnostic Laparoscopy: ****

- A limited diagnostic laparoscopy is performed to rule out other intra-abdominal pathologies, ensuring that the appendicitis diagnosis is confirmed and there are no other complications that require attention.

5. ****Identification of the Appendix: ****

- The appendix is located by identifying the caecum and tracing the taenia coli, which are longitudinal muscle bands, to the base of the appendix.
- Careful attention is paid to dissecting any adhesions between the appendix and surrounding organs to prevent inadvertent injury to the bowel or other structures.



****Fig 8. Port Position in Appendectomy****

The diagram typically illustrates the placement of ports for appendectomy, highlighting the strategic positions that allow optimal visualization and maneuverability during the procedure. This configuration ensures safe and effective appendectomy while minimizing the risks associated with intra-abdominal surgery.

This conventional laparoscopic approach, with the camera port at the umbilicus, has been refined over years of practice to offer a balance between efficacy, safety, and patient outcomes in the treatment of acute appendicitis.

- Alternative Port and Theatre Set-up: For a cosmetic reason, the baseball diamond concept of port position can be altered and three ports should be placed in such a way so that the two 5 mm port will be below the bikini line. Access should be performed by a 10 mm umbilical port. Once the laparoscope is inside, one 5 mm port should be placed in left iliac fossa below the bikini line under vision. The second 5 mm port should be placed in the right iliac fossa, just mirror image of left port. After fixing all the ports in position, another 5 mm laparoscope is introduced through left iliac fossa, and surgery should be performed through umbilical port (for right hand) and left iliac fossa port (for left hand). In this alternative port position, a 60° manipulation angle cannot be achieved and it is ergonomically difficult for the surgeon, but the patient will get a cosmetic benefit. This alternative port position for laparoscopic appendicectomy should not be performed in the case of retrocecal appendix or perforated appendix.

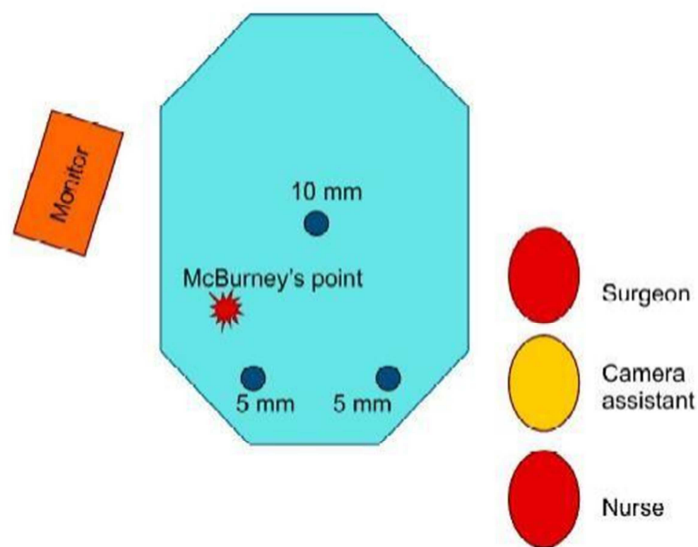


Fig 9: Alternative port position

Once the appendix is freed from its surrounding attachments, the surgical team proceeds with isolating the mesoappendix, which involves securing the blood supply to the appendix. This step is crucial to prevent excessive bleeding and ensure a safe removal of the appendix. Here are the detailed techniques commonly employed:

****Isolation of Mesoappendix: ****

After freeing the appendix, the mesoappendix (the tissue connecting the appendix to the surrounding structures) is isolated using one of the following methods:

1. ****Monopolar Hook with Diathermy Dissection: ****

- A monopolar hook is utilized to dissect and isolate the appendiceal artery.
- Diathermy (electrosurgical energy) is applied through the hook to cut and coagulate tissues, ensuring precise dissection while minimizing bleeding.

2. ****Maryland Dissector: ****

- Alternatively, a Maryland dissector may be employed to bluntly isolate the appendiceal artery.
- This instrument allows for a gentle separation of tissues without the use of electrical energy, suitable for delicate dissection around vascular structures.

****Ligation of Appendiceal Artery: ****

Once the appendiceal artery is identified and isolated, it is ligated (tied off) to prevent bleeding and facilitate safe removal of the appendix. Several techniques are used for this purpose:

1. ****Clip Application: ****

- Small polymer or titanium clips are applied to securely occlude the appendiceal artery.
- These clips provide a mechanical closure of the vessel and are particularly effective in maintaining haemostasis.

2. ****Bipolar Vessel Sealing: ****

- Bipolar vessel sealing devices are utilized to coagulate and seal the appendiceal artery using controlled electrical energy.
- This method ensures rapid and effective sealing of blood vessels, reducing the risk of postoperative bleeding.

3. ****Ultrasonic Vessel Sealing: ****

- For smaller arteries (less than 8 mm in size), ultrasonic energy devices may be employed.
- These devices utilize ultrasonic vibrations to denature and seal the vessel walls, achieving haemostasis without the need for clips or ties.

Each of these techniques for isolating and ligating the appendiceal artery during laparoscopic appendectomy contributes to the safety and efficiency of the procedure. The choice of method may depend on the surgeon's preference, patient anatomy, and specific clinical circumstances encountered during surgery.

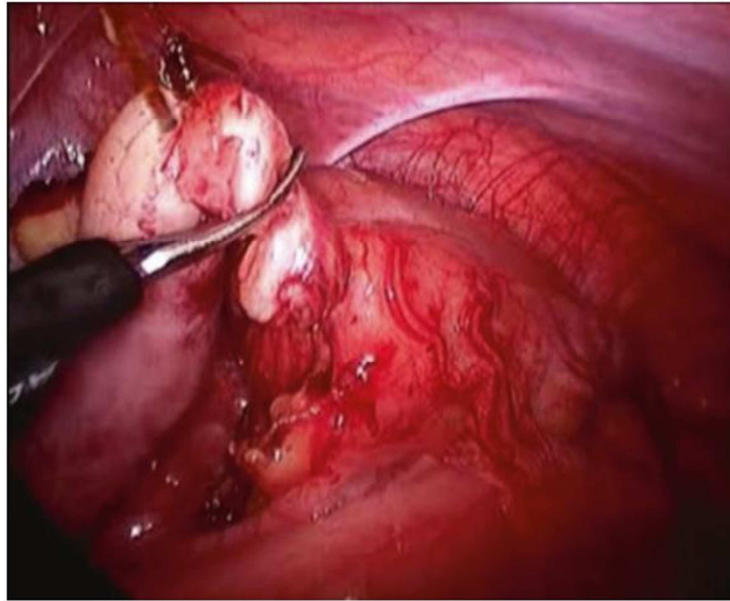


Fig 10: Vessel sealing

- After isolating and ligating the appendiceal artery during laparoscopic appendectomy, the next step involves ensuring complete exposure of the base of the appendix for secure ligation. Here are the techniques commonly used for ligation at the base of the appendix:

****Exposure and Ligation of Appendix Base: ****

To prepare the appendix for removal, the base must be fully exposed and free of surrounding fat tissue. This ensures effective closure and prevents postoperative complications. The following techniques are employed:

1. ****Simple Suture Ligation: ****

- Intracorporeal suturing is performed using a 2-0 braided suture on a round half-circle needle.
- Two sutures are placed on the patient side (proximal to the appendix base) and one on the specimen side (distal to the appendix base).
- This method allows for precise closure of the appendiceal base using sutures, ensuring secure ligation.

2. ****Endoloop™ (Johnson & Johnson, USA): ****

- Commercially available preformed suture loops (Endoloop™) of 2-0 braided suture are used to create a loop ligation around the base of the appendix.
- Two loops are placed on the patient side and one on the specimen side, providing a reliable closure mechanism.
- Endoloops facilitate efficient and secure closure of the appendix base without the need for extensive suturing.

3. ****Plastic Clips (Hem-o-a™, Teleflex Medical, USA): ****

- Plastic clips are applied to ligate the base of the appendix.
- Two clips are placed on the patient side (proximal) and one on the specimen side (distal).

- Hem-o-lock™ clips provide a mechanical closure and are easy to apply, ensuring effective haemostasis and closure of the appendiceal base.

These techniques ensure that the base of the appendix is adequately secured and prepared for removal during laparoscopic appendectomy. The choice of method may depend on surgeon preference, availability of equipment, and specific patient factors encountered during the procedure. Each technique aims to minimize postoperative complications and facilitate a successful surgical outcome.

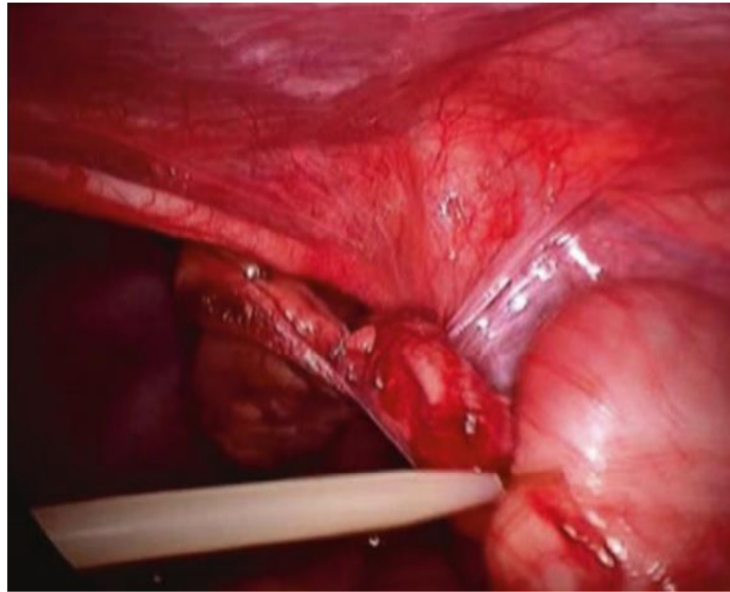


Fig 11: Endoloop for ligation at the base of the appendix

- The ligated appendiceal base can now be cut using the laparoscopic shears

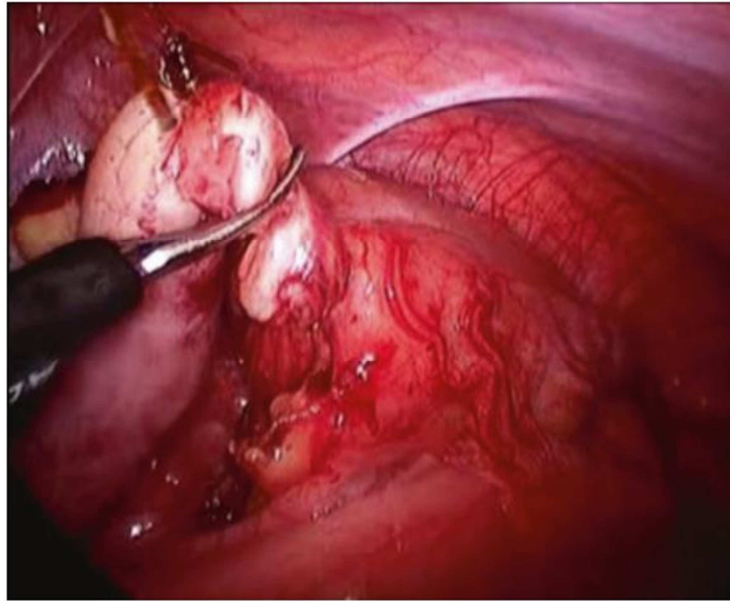


Fig 12: Cutting the appendiceal base with shears

The mucosa of the appendiceal stump is carefully suctioned to ensure no faecolith remains and is cauterized with bipolar energy to prevent rare mucocele formation ^[41]. The stump and surrounding area are inspected for faecal contamination, bleeding, and bowel perforation. Clotted blood and purulent material are suctioned, and lavage is optionally used based on the presence of faecal contamination.

A sterile 10 × 5 cm plastic bag with a 35 cm nonabsorbable suture attached with a Roeder's knot is inserted through the umbilical port. The appendix is placed inside the bag, closed, and extracted through the umbilical port to reduce infection risk at the incision site ^[42]. Alternative methods include using a condom inserted through the umbilical port to retrieve the appendix, or using a 5 mm scope and bowel grasper to place the specimen in the bag for extraction under direct vision.

Peritoneal lavage is performed if necessary, and a closed suction drain is inserted for perforated appendicitis cases. After specimen extraction, desufflation is performed, and trocars are inspected for port site bleeding using a scope through the umbilicus. Haemostasis is ensured before closing the fascial layer of the umbilical incision with figure-of-eight sutures using a 2–0 braided absorbable suture. Subdermal interrupted skin closure is achieved with 4–0 monofilament absorbable sutures, followed by application of film dressings over the incision sites.^[42]

Postoperative care includes early ambulation, progressive diet as tolerated, and discharge expected on the first postoperative day for uncomplicated appendicitis. Patients are scheduled for follow-up one week after surgery.

REVIEW OF PAST LITERATURE RELEVANT TO THE PRESENT STUDY

Ingraham AM et al. (2010) conducted a study using the American College of Surgeons National Surgical Quality Improvement Program (ACS NSQIP) database compared outcomes between laparoscopic appendectomy (LA) and open appendectomy (OA) for acute and complicated appendicitis. Out of 32,683 patients analysed, 24.6% underwent LA and 23.6% underwent OA. The study found that patients undergoing LA had significantly lower rates of individual infectious complications compared to OA, except for organ space surgical site infections (SSI). However, patients with complicated appendicitis undergoing LA were at higher risk of developing organ space SSI. For patients with acute appendicitis, the choice between LA and OA was similar in academic-affiliated and community hospitals. Operative durations were longer at academic centres for both LA and OA. Despite

this, the median length of hospital stay after LA was one day at both types of hospitals. In conclusion, LA appears to be associated with lower overall morbidity in selected patients within ACS NSQIP hospitals. However, patients with complicated appendicitis may face increased risks of organ space SSI with LA. Academic affiliation did not affect the choice of surgical approach, but LA was associated with slightly longer operative times compared to OA in academic settings.^[10]

Domene CE et al. (2014) described a low-cost, aesthetic laparoscopic technique for ileocecal appendix removal with three ports. The technique involves three incisions, one umbilical and two suprapubic ports, using permanent materials like grasping forceps, hook, scissors, needle holders, metal trocars, and cotton. This method eliminates the need for operative extractors, bags, clips, endoloops, staples, or other instruments. The technique is safe, reproducible, easily teachable, and can be applied in general hospitals using conventional laparoscopic equipment.^[24]

Kollmar O et al. (2002) developed two alternative laparoscopic routes for appendectomy using suprapubic incisions placed below the pubic hair line. A retrospective study compared operative characteristics, morbidity, outcomes, and patient preferences across three different approaches to laparoscopic appendectomy. From 1997 to 2000, 149 patients underwent the procedure and were categorized into three groups based on technique. Operative outcomes, morbidity rates, and hospital stays were comparable among the groups. Cosmetic preference overwhelmingly favoured the approach using two suprapubic trocars, with 92% of patients in technique 1 and 100% in techniques 2 and 3 opting for this method. The study concluded that the use of suprapubic trocars enhances the surgeon's ergonomic position during the procedure. According to the majority of patients and healthy

individuals interviewed, a laparoscopic approach utilizing two suprapubic trocars provided the most favourable cosmetic outcomes.^[43]

Palanivelu C et al. (2007) assessed the benefits of laparoscopy in treating appendicitis and enumerated the advantages of laparoscopy in a group of 7,210 patients over 14 years. The study enrolled patients with unique conditions such as subhepatic appendicitis, appendicitis in midgut malrotation, appendicitis in situs inversus totalis, and appendicitis in the lateral pouch position. All participants underwent laparoscopic appendectomy as part of the study protocol. Results showed that patients with subhepatic appendicitis, appendicitis in situs inversus, and appendicitis in the lateral pouch position had an uneventful postoperative course. However, patients who underwent appendectomy as part of malrotation treatment and those with perforated subhepatic appendix had slightly longer hospital stays. The study concluded that diagnostic laparoscopy through the umbilical port helped confirm the diagnosis, and the technique was modified to suit each patient.^[44]

Zubair M et al. (2009) conducted a prospective descriptive study and evaluated the results of Laparoscopic Appendectomy using a midline suprapubic port for camera. The study included 34 patients (21(61.76%) males and 13(38.24%) females), with a mean age of 25.12 years. The operative time was 54.39 minutes, with 3(8.82%) requiring conversion to open appendectomy and 2(5.88%) developing wound infection. The mean hospital duration stay was 1.29 days. The study stated that Laparoscopic Appendectomy with a suprapubic camera port is a safe and attractive option.^[45]

Vidal O et al. (2011) analysed the initial experience with suprapubic SILS appendectomy in patients with acute appendicitis. The study involved 20 patients, with a mean age of 30 ± 3 years, who underwent the procedure. The average duration of the operation was 40 ± 7 minutes, with four patients requiring a suction drain. The hospital stay was 2 ± 0.5 days. All patients completed the operation successfully, and no complications occurred. The appearance of the suprapubic wound was good 7 days after surgery. The research findings indicated that suprapubic single-incision laparoscopic surgery (SILS) appendectomy provides superior cosmetic outcomes compared to traditional umbilical access. This approach facilitates easier access and dissection of the appendix, allowing for the placement of a drain without the need for additional lateral incisions.^[46]

In a prospective hospital based descriptive study conducted at Bihar, Singh MK et al. (2013) evaluated the results of laparoscopic appendectomy using two suprapubic port incisions placed below the pubic hair line. The study involved 75 patients with acute appendicitis, with a total of 46 females and 29 males. The mean age was 30.32 ± 8.86 years, and the mean operative time was 27.2 ± 5.85 minutes. One (1.33%) patient required conversion to open appendectomy, and no patient developed wound infection or any other complication. The mean hospital stay was 22.34 ± 12.18 hours. Almost all patients were satisfied with their cosmetic results. The study concluded that using two suprapubic ports yields better cosmetic results and improves the surgeon's working position during laparoscopic appendectomy. However, further comparative studies and randomized controlled trials are needed to confirm these findings.^[47]

Jategaonkar PA et al. (2013) discussed a modified trans-umbilical appendectomy for acute appendicitis using routine instruments. From August 2009 to March 2011, 164 patients were operated using this technique at a rural centre. The mean age for males was 27.5 years (range, 14-51), and females was 31.2 years (range, 17-48). Three umbilical ports were strategically placed to dissect the appendix, and routine laparoscopic instruments were used. The mean operative time was 45 minutes, with a 1.8% conversion rate to conventional laparoscopy. Average blood loss was 15 ml, and one caecal electrosurgical injury was managed expectantly. Umbilical sepsis and seroma were 3% and 6.1%, respectively. Patients were discharged after an average of 1.3 days, and the scars receded in the umbilicus, giving a near-scarless abdomen. The method described is feasible and safe for managing acute appendicitis, and can be easily learned by a laparoscopic surgeon. It may stand out in providing benefits of modern surgery to the population of developing countries. ^[48]

Carter JT et al. (2014) conducted a prospective, randomized controlled trial comparing single-incision laparoscopic surgery (SILS) and traditional 3-port laparoscopic appendectomy in adults with uncomplicated acute appendicitis. The primary endpoint was early postoperative pain, with secondary endpoints including operative time, complication rate, recovery time, and long-term body image and cosmetic appearance assessed after six months. The study was halted after enrolling 75 patients due to findings that SILS patients experienced more postoperative pain (pain score: 4.4 ± 1.6 vs 3.5 ± 1.5 ; $p = 0.01$) and higher inpatient opiate usage (hydromorphone use: 3.9 ± 1.9 mg vs 2.8 ± 1.7 mg; $p = 0.01$) compared to those who underwent 3-port laparoscopy. Operative time for SILS was 40% longer, although only one case required conversion to the 3-port approach. There were no significant differences between the groups in terms of length of hospital stay, complications, oral

pain medication usage after discharge, or time to return to work. Patients in the 3-port group reported better physical attractiveness, while SILS patients were more satisfied with their scars. Long-term assessments of body image and cosmetic appearance were excellent in both groups. The study concluded that while SILS appendectomy did not improve short-term recovery or complications, it resulted in more postoperative pain and longer operative times compared to the traditional 3-port laparoscopic approach.^[49]

In a retrospective study, Que Son T et al. (2022) compared the surgical outcomes of the SILA (Single Incision Laparoscopic Appendectomy) with three laparoscopic appendectomies (TLA) procedures. The study examined 68 patients who underwent laparoscopic appendectomy by a single surgeon. Results showed no significant differences in operation time, hospital stay, postoperative pain, or morbidity between SILA and TLA patients ($P\text{-value} > 0.05$). There were no differences in the mean visual analogue scale score between the two groups on the first, second, and discharge days. However, two short-term complications were noted in the SILA suprapubic and one in the TLA group. The study concluded that SILA performed through a handmade surgical-glove port is a safe and viable therapy option for mild-to-moderate appendicitis.^[50]

MATERIALS AND METHODS

Source of Data: The source of data was patients with appendicitis undergoing laparoscopic appendectomy admitted in general surgery wards at KAHER'S Dr. Prabhakar Kore Charitable Hospital and Medical Research Centre, Nehru Nagar, Belagavi.

- a) **Study design:** Prospective cross sectional study
- b) **Duration of data collection:** 1 year
- c) **Study Period:** September 2022 to August 2023.
- d) **Sample size:** 60

All patients coming to the institution with complaints suggestive of appendicitis and willing to undergo appendectomy during the study period were included. These patients were divided into two groups, patients undergoing laparoscopic appendectomy with either of the two which is umbilical camera port and the suprapubic camera port. But for statistical significance, we intend to include at least 30 patients in each appendectomy group.

Group A – Patients undergoing Laparoscopic appendectomy with camera at the umbilical port.

Group B – Patients undergoing Laparoscopic appendectomy with camera at the suprapubic port.

NOTE- The first port or the insertion of the camera was through the umbilical port and then the camera was shifted to suprapubic port.

e) **Sampling procedure:** Universal sampling

f) **Selection criteria**

g) **Inclusion criteria**

a. Willing to participate in the study

b. Clinical diagnosis of appendicitis and patients undergoing laparoscopic appendectomy.

c. More than 18 years and less than 70 years

h) **Exclusion criteria**

a) Patients undergoing surgery where appendectomy was part of another procedure.

b) Patients who had undergone a previous abdominal surgery.

c) Bleeding disorders

d) Not willing to give consent.

i) **Study protocol:**

Once informed consent was signed, necessary personal information and detailed medical history was taken by the investigator. After this, imaging (USG/CT) was conducted to determine the diagnosis, and the surgical procedure, i.e., laparoscopic appendectomy, was carried out.

The diagnosis of appendicitis was made using a combination of clinical symptoms, signs, and investigations. The data was recorded using a pretested standard proforma. Universal sampling was done, and all patients satisfying the inclusion criteria were included in the study. Patient demographic details, signs, and symptoms,

along with detailed history, were recorded. Laboratory investigations, including a complete blood count, serum creatinine, liver function test, and serum electrolytes, were conducted and data recorded. Initial radiological evaluation was done with ultrasonography in all patients. Further imaging was performed with contrast-enhanced CT in selected patients for further evaluation. Laparoscopic appendectomy with suprapubic and umbilical camera ports was done for visualization of the appendix. Data was entered and analysed in Microsoft Excel. The data collected underwent a statistical test called analysis of variance (ANOVA).

Investigations done:

1. Complete blood count
2. Liver function test
3. Serum creatinine
4. Imaging (USG/CT) for determining the diagnosis

j) Statistical analysis:

The data collected underwent a statistical test called analysis of variance (ANOVA) to evaluate the significance of the independent variables in predicting the performance indicator with the help of a 'p test'. The graph of sensitivity and specificity (Receiver Operating Characteristic curve) was plotted in Microsoft Excel. P value less than 0.05 was considered statistically significant. S-significant, NS- non significant.



Fig 13: The port/trocar placement in the study demonstrating two 10mm ports inserted at the suprapubic and the umbilical regions with one 5mm port at the left iliac fossa.

RESULTS

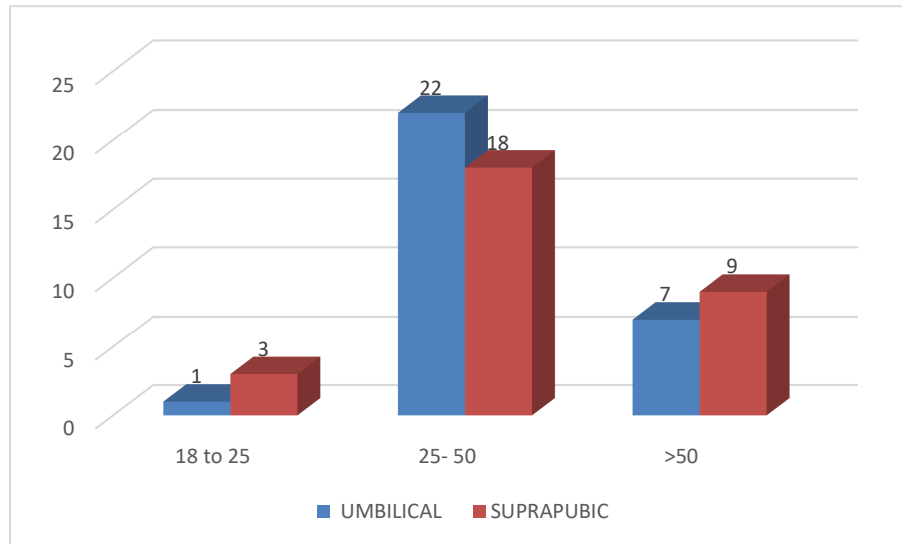
Present study was conducted among 60 cases of appendectomy. Two groups were made.

Patients undergoing surgery with the camera at the umbilical port group had 30 cases Patients undergoing surgery with the camera at the suprapubic port group had 30 cases.

Table 1. Age distribution among study population

Age in years	UMBILICAL	SUPRAPUBIC
18 to 25	1	3
25- 50	22	18
>50	7	9
Total	30	30
P value	0.07	NS

Graph 1. Age distribution among study population

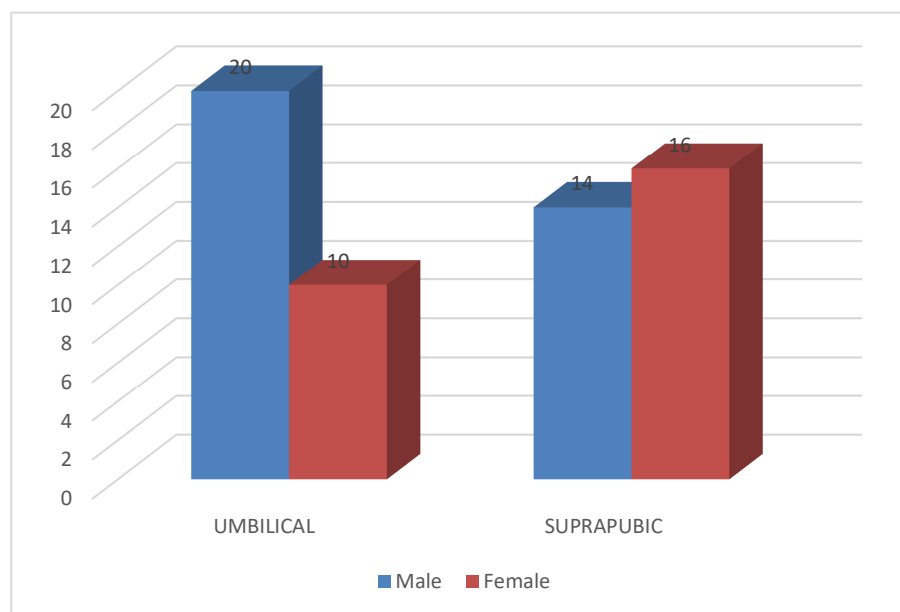


The data indicates that the average age of patients in the suprapubic camera port group is 39.8 years (SD = 12.2), while the average age in the umbilical camera port group is 37.1 years (SD = 11.8). This suggests that patients in the umbilical camera port group tend to be slightly older on average and have a wider age range compared to those in the suprapubic camera port group.

Table 2. Gender distribution among study population

Gender	UMBILICAL	SUPRAPUBIC
Male	20	14
Female	10	16
Total	30	30
P value	0.06	NS

Graph 2. Gender distribution among study population

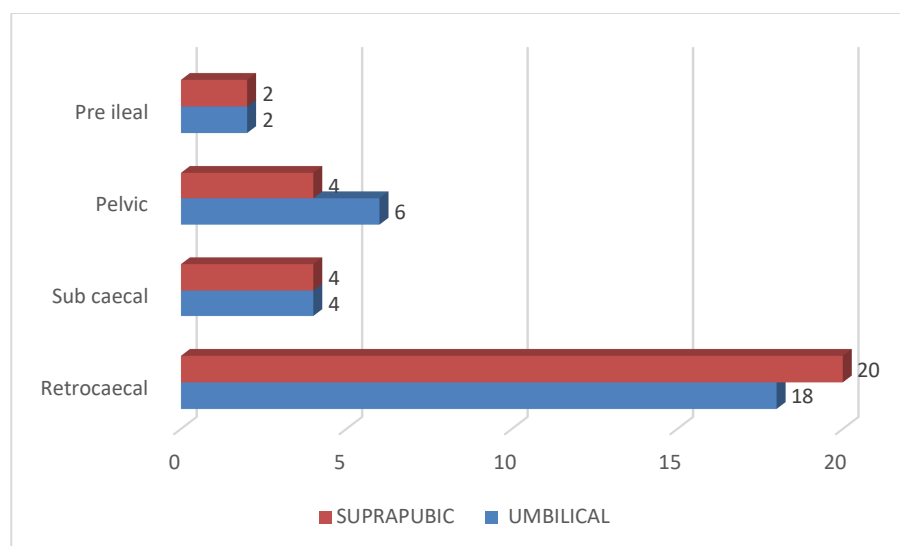


The data provided presents the gender distribution in two groups: suprapubic camera port and umbilical camera port. In the suprapubic camera port group, there were 14 males and 16 females, while in the umbilical camera port group, there were 20 males and 10 females. This indicates that in both groups, there were more males than females.

Table 3: Distribution depending on position of appendix

Position of appendix	UMBILICAL	SUPRAPUBIC
Retrocaecal	18	20
Sub caecal	4	4
Pelvic	6	4
Pre ileal	2	2
Total	30	30

Graph 3: Distribution depending on position of appendix



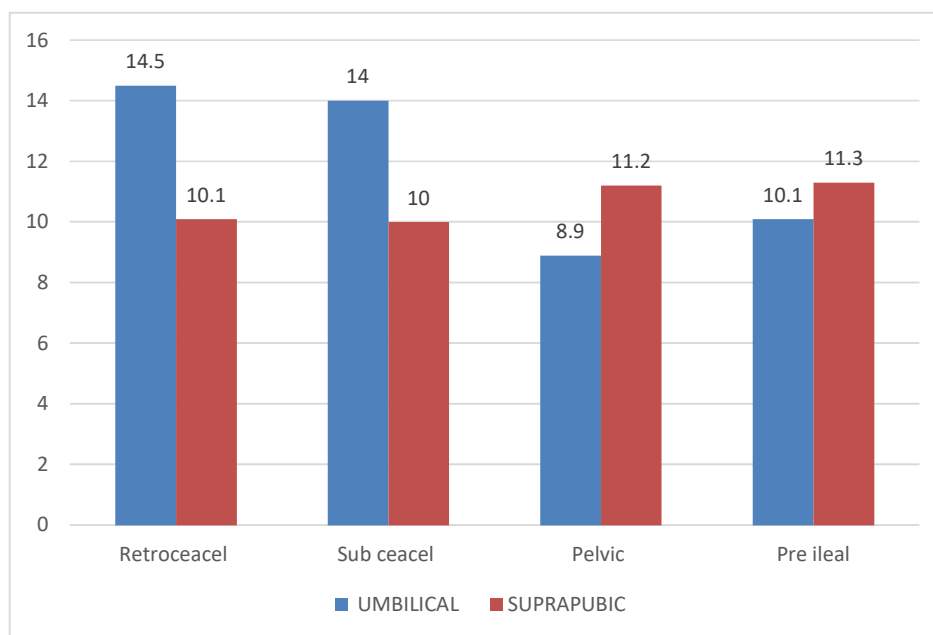
The table represents the different position of the appendix in both the camera port groups. The appendix can be located in various positions, with the retrocaecal position being the most common, found in 18 cases in the umbilical camera port and 20 in the suprapubic camera port. The subcaecal position is equally observed in both groups, with 4 cases each. The pelvic position shows slight variation, appearing in 6

cases in the umbilical camera port and 4 in the suprapubic camera port. The pre-ileal position is the least common, found in 2 cases in both groups.

Table 4. Variability in the anatomical location of the appendix and time taken for visualization of appendix from the start of surgery.

Position of appendix	UMBILICAL	SUPRAPUBIC
	Time in min	Time in min
Retrocaecal	14.5	10.1
Sub caecal	14	10
Pelvic	8.9	11.2
Pre ileal	10.1	11.3

Graph 4 .Variability in the anatomical location of the appendix and time taken for visualization of appendix from the start of surgery.

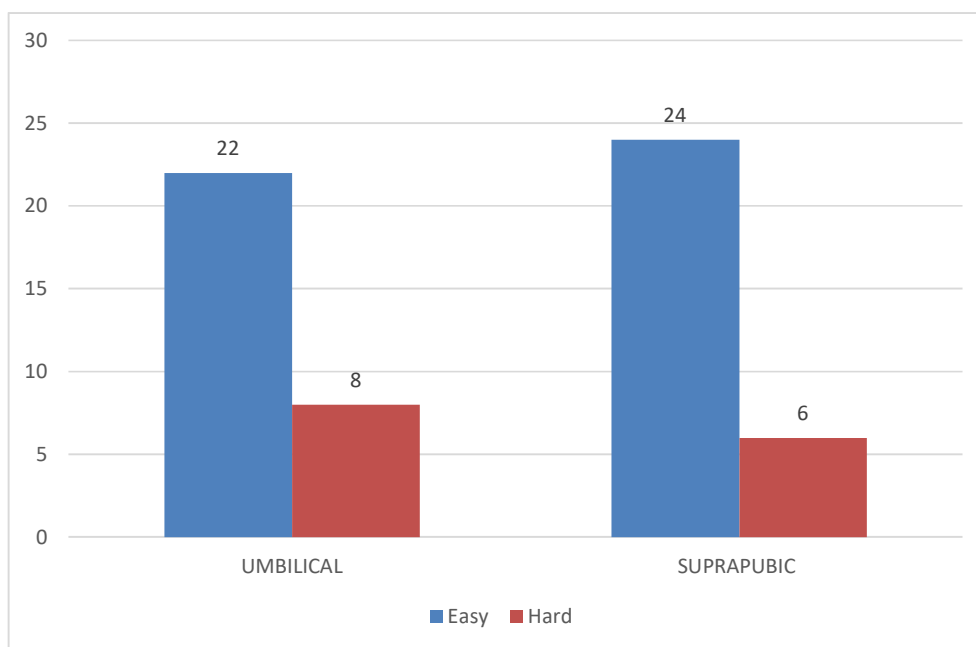


The table outlines the time taken in minutes for visualization of appendix in various anatomical positions. Umbilical camera port and suprapubic camera port. For the retrocaecal appendix, the time is 14.5 minutes in the umbilical camera port and 10.1 minutes in the suprapubic camera port. In the subcaecal position, it takes 14 minutes in the umbilical camera port and 10 minutes in the suprapubic camera port. For the pelvic position, it takes 8.9 minutes and 11.2 minutes in the umbilical and suprapubic camera ports, respectively. Lastly, for the pre-ileal position, the times are 10.1 minutes in the umbilical camera port and 11.3 minutes in the suprapubic camera port. This data indicates variability in the time taken based on the position of the appendix and the abdominal region considered.

Table 5. Distribution depending on easiness to trace bowel and ileocaecal Junction.

Trace bowel	UMBILICAL	SUPRAPUBIC
Easy	22	24
Hard	8	6
Total	30	30
P value	0.27	NS

Graph 5. Distribution depending on easiness to trace bowel and ileocaecal Junction.



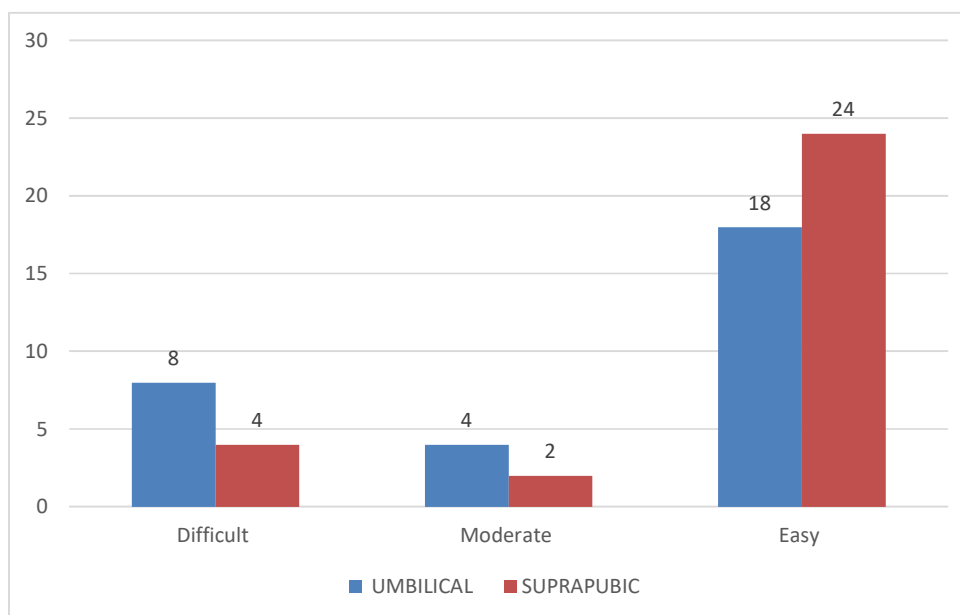
The provided data outlines the frequency of different bowel tracing and visualization of ileocaecal junction difficulty levels for two surgical approaches: umbilical and suprapubic camera ports. The easiness for bowel tracing and visualization of ileocaecal junction was categorized as easy or hard. It was categorized as 'easy' when there were no adhesions, no ileocaecal junction pathology, or edematous / inflamed bowel, whereas it was graded 'hard' when there was presence of either of the above mentioned.

In the umbilical camera port approach, 22 cases were categorized as "Easy" in bowel tracing and visualization of ileocaecal junction, while 8 cases were classified as "Hard." Conversely, in the suprapubic camera port approach, 24 cases were deemed "Easy" and 6 cases were categorized as "Hard" in bowel tracing with visualization of ileocaecal junction. This data suggests that bowel tracing tends to be easier in the suprapubic camera port approach compared to the umbilical camera port approach, with a higher proportion of "Hard" cases observed in the latter. Understanding these trends can inform surgical strategies and resource allocation to ensure optimal outcomes for patients undergoing procedures involving bowel tracing and visualization of ileocaecal junction.

Table 6: Distribution depending on ease of dissection

Ease of dissection	UMBILICAL	SUPRAPUBIC
Difficult	8	4
Moderate	4	2
Easy	18	24
P value	0.23	NS

Graph 6. Distribution depending on ease of dissection



The data compares the ease of dissection between umbilical and suprapubic camera port approaches.

The ease of dissection was analysed based on the three variables:

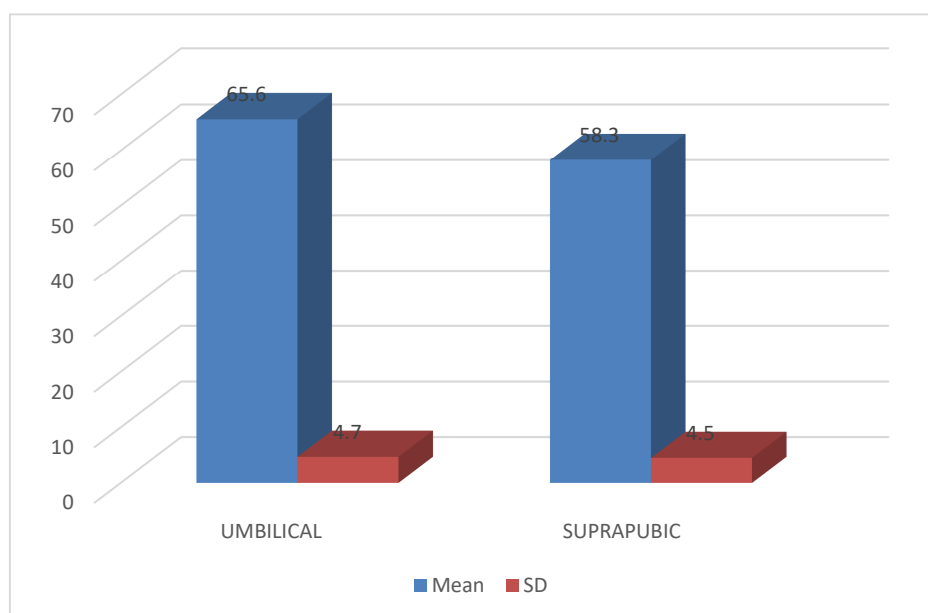
1. Dissection of the mesoappendix
2. Ligation of the base
3. Release of adhesions

The ease of dissection of appendix was categorized as easy, moderate or hard. It was categorized as 'easy' when shorter time was taken for dissection of mesoappendix, ligation of base and with no adhesions present. It was categorized 'moderate' when average time was taken for dissection of mesoappendix, ligation of base with presence of minimal adhesions. It was categorized as 'difficult' when longer time was taken for dissection of mesoappendix, ligation of base with presence of dense adhesions. The umbilical camera port approach is perceived as difficult in 8 cases, moderate in 4 cases, and easy in 18 cases. In contrast, the suprapubic camera port approach is considered difficult in 4 cases, moderate in 2 cases, and easy in 24 cases. This suggests that the suprapubic camera port approach is generally easier, as evidenced by a higher number of cases (24) categorized as easy compared to the umbilical camera port approach, which has 18 easy cases and more instances of difficult (8) and moderate (4) cases.

Table 7. Distribution depending on operative time for surgery

Time in min	UMBILICAL	SUPRAPUBIC
Mean	65.6	58.3
SD	4.7	4.5
P value	0.0009	S

Graph 7. Distribution depending on operative time for surgery



The data provided illustrates the mean and standard deviation of procedure durations in minutes for two distinct surgical sites: umbilical camera port and suprapubic camera port. Procedures at the umbilical camera port site demonstrate a longer mean duration of 65.6 minutes with a higher standard deviation of 4.5 minutes, suggesting a greater degree of variability and generally longer procedures compared to the suprapubic camera port site

Conversely, Procedures at the suprapubic camera port site have a mean duration of 58.3 minutes with a standard deviation of 4.7 minutes, indicating moderate variability around this average.

Most of the appendix in the operated cases were retrocaecal in position and hence it was easier to visualize and operate.

DISCUSSION

Age Distribution: The present study showed that the average age of patients in the suprapubic camera port group was 39.8 years (SD = 12.2), while the average age in the umbilical camera port group was 37.1 years (SD = 11.8). This suggests that patients in the umbilical camera port group tend to be slightly older and have a wider age range. However, the difference in age distribution between the two groups was not statistically significant (P = 0.07). Zubair M et al. (2009)^[45] showed that mean age was 25.12 years and in study by O Vidal et al. (2011)^[46] mean age was 20+3 years.

A study conducted at Bihar, by Singh MK et al. (2013)^[47] found mean age to be 30.32 ±8.86 years. Jategaonkar PA et al. (2013)^[48] found that age range was 17 to 48 years and mean was 31.2 years.

Gender Distribution: The present study showed that the umbilical camera port group included 20 males and 10 females, whereas the suprapubic camera port group had 14 males and 16 females. Although there were more males than females in both groups, the gender distribution difference was not statistically significant (P = 0.06). Zubair M et al. (2009)^[45] showed that 61.76% were males and 38.24% were females. Study conducted at Bihar, by Singh MK et al. (2013)^[47] also found that females (46) were more than males (29).

Position of the appendix: The present study showed that the retrocaecal position of the appendix was the most common in both groups, with 18 cases in the umbilical camera port group and 20 cases in the suprapubic camera port group. The subcaecal and pre-ileal positions were equally observed in both groups, while the pelvic position varied slightly, with 6 cases in the umbilical camera port group and 4 in the

suprapubic camera port group. Even the literature states the dominance of the retrocaecal position of appendix as the most common position.

Visualization Time of appendix from the start of surgery: The present study showed that the suprapubic camera port generally allowed quicker visualization of the appendix compared to the umbilical camera port. For example, the retrocecal position took 14.5 minutes to visualize with the umbilical camera port and 10.1 minutes with the suprapubic camera port. Similarly, subcaecal position took 14 minutes with the umbilical camera port and 10 minutes with the suprapubic camera port. However, for pelvic appendix and pre-ileal appendix positions, the times were slightly longer with the suprapubic camera port. As the literature states that the most common position of appendix is retrocaecal, it was better visualized by the suprapubic camera port but significant difference was observed in the pelvic and preileal appendix due to its position and the extent of umbilical camera port approach was better in these two positions.

Bowel Tracing and Visualization of Ileocaecal junction: The present study showed that bowel tracing and visualization of the ileocaecal junction tended to be easier with the suprapubic camera port approach (24 easy cases, 6 hard cases) compared to the umbilical camera port approach (22 easy cases, 8 hard cases). Nonetheless, this difference was not statistically significant ($P = 0.27$). Though it was not statistically significant, suprapubic camera port was slightly superior to the umbilical camera port due to the position of appendix and direct visualization of the ileocaecal junction.

Ease of Dissection: The present study showed that the dissection process was generally easier with the suprapubic camera port approach (24 easy cases, 4 difficult cases) compared to the umbilical camera port approach (18 easy cases, 8 difficult

cases). Moderate difficulty was less common in both groups. This ease of dissection was evaluated based on the dissection of the mesoappendix, ligation of the base, and release of adhesions. The difference in ease of dissection between the groups was not statistically significant ($P = 0.23$). Though it was not statistically significant, the dissection was superior in the suprapubic camera port compared to the umbilical camera port.

Operative Time: The present study showed that the mean operative time was shorter for the suprapubic camera port group (58.3 minutes, $SD = 21.2$) compared to the umbilical camera port group (65.6 minutes, $SD = 26.8$). This difference in operative time was statistically significant ($P = 0.0009$), indicating that the suprapubic camera port approach may facilitate a quicker procedure. Zubair M et al. (2009) ^[45] showed that mean time required for operation was 54.39 min. Mean operative time in study by O Vidal et al. (2011) ^[46] mean operating time was 40 ± 7 min. Vilallonga R et al. (2012) ^[51] found that mean operating time for Single Port Access (SPAA) is 40.4 min.

The study by Kollmar O et al. (2002) ^[43] concluded that positioning suprapubic trocars enhances the surgeon's ergonomic efficiency during laparoscopic appendectomy. Moreover, using two suprapubic trocars in the laparoscopic approach results in superior cosmetic outcomes according to the majority of patients and healthy participants, whereas study by Palanivelu C et al. (2007) ^[44] concluded that performing diagnostic laparoscopy via the umbilical port effectively confirmed the diagnosis, with the technique. Similarly, study by C. Zubair M et al. (2009) ^[45] showed that laparoscopic appendectomy using a suprapubic camera port is a safe and appealing option and study by O Vidal et al. (2011) ^[46] concluded that suprapubic SILS appendectomy provides superior, cosmetically appealing results compared to

standard umbilical access. It facilitates easier access and dissection of the appendix and allows for the exteriorization of a drain without the need for additional lateral incisions. Study conducted at Bihar, Singh MK et al. (2013) ^[47] found mean operating time to be 27.2±5.85 minutes. Jategaonkar PA et al. (2013) ^[48] found that average operative duration was 45 minutes, with a conversion rate to conventional laparoscopy of 1.8%.

CONCLUSION

The present study provides valuable insights into the comparative efficacy and outcomes of using suprapubic versus umbilical camera ports in appendectomy procedures. It was observed that while the average age and gender distribution differences between the two groups were not statistically significant, there were notable differences in operative times and ease of visualization and dissection of appendix. Specifically, the suprapubic camera port approach demonstrated a statistically significant reduction in operative time and generally facilitated easier visualization and dissection of the appendix. This was particularly evident in the quicker visualization times for retrocaecal and subcaecal locations of appendix, suggesting that the suprapubic camera port approach might be more efficient in these cases.

Moreover, the suprapubic camera port approach showed a trend towards easier bowel tracing and visualization of the ileocaecal junction and the visualization of position of appendix, as well as a greater ease of dissection, although these differences were not statistically significant. These findings suggest that while both approaches are viable, the suprapubic camera port may offer some advantages in terms of operative efficiency and procedural ease and another advantage being that there was no need to change the camera from 10mm to 5mm for extraction of the appendix, as in this study two ports of 10mm were used allowing extraction of the appendix from the either of the ports.

However, further studies with larger sample sizes and additional variables may be necessary to confirm these findings and to explore any potential benefits in patient outcomes and recovery times. Overall, the study highlights the importance of considering anatomical variations and procedural techniques in optimizing surgical outcomes for appendectomies.

SUMMARY

Age Distribution: The present study showed that the average age of patients in the suprapubic camera port group was 39.8 years (SD = 12.2), while the average age in the umbilical camera port group was 37.1 years (SD = 11.8). Patients in the umbilical camera port group tend to be slightly older and exhibit a wider age range. The age distribution difference is not statistically significant ($P = 0.07$).

Gender Distribution: The suprapubic camera port group includes 14 males and 16 females, whereas the umbilical group has 20 males and 10 females. Although there are more males than females in both groups, the gender distribution difference is not statistically significant ($P = 0.06$).

Position of appendix: The retrocaecal position is the most common in both groups (18 cases in umbilical, 20 in suprapubic). Subcaecal appendix and pre-ileal appendix positions are equally observed in both groups, while the pelvic appendix position varies slightly (6 in umbilical, 4 in suprapubic) and is the least common in both the groups.

Visualization Time of appendix from the start of surgery: The suprapubic camera port generally allows quicker visualization of the appendix compared to the umbilical camera port, especially for retrocaecal and subcaecal positions. However, pelvic and pre-ileal positions take slightly longer with the suprapubic camera port due to anatomical considerations.

Bowel Tracing and Visualization of Ileocaecal Junction: The suprapubic camera port approach tends to make bowel tracing and visualization of the ileocaecal junction easier (24 easy, 6 hard) compared to the umbilical camera port approach (22 easy, 8 hard), although this difference is not statistically significant ($P = 0.27$).

Ease of Dissection: Dissection is easier with the suprapubic camera port approach (24 easy, 4 difficult) than the umbilical camera port approach (18 easy, 8 difficult), with moderate difficulty less common in both groups. This ease is analysed based on mesoappendix dissection, ligation of the base of appendix, and release of the adhesions. The difference is not statistically significant ($P = 0.23$).

Operative Time: The mean operative time is shorter for the suprapubic camera port group (58.3 minutes, $SD = 21.2$) compared to the umbilical camera port group (65.6 minutes, $SD = 26.8$). The difference in operative time is statistically significant ($P = 0.0009$).

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ANNEXURE - I

INFORMED CONSENT FORM

KAHERs JNMC BELAGAVI

Principal Investigator, REG NO.BH0121006

Title of the study: Suprapubic vs Umbilical port for visualization of appendix in laparoscopic appendectomy and to determine the easiness of surgery: One year prospective cross sectional study

Purpose of the study:

To compare suprapubic vs umbilical camera port for visualization of appendix in laparoscopic appendectomy.

1. To visualize the position of appendix
2. To determine the Ease of surgery

Introduction

Acute appendicitis is most common emergency that presents to casualty, with complains of acute pain abdomen, which requires quick diagnosis and intervention. In complicated appendectomies, conversion to open surgery may be required to perform a safe appendectomy and to avoid any surgical complications. It would be ideal to have pre-operative predictors which will help us identify patients with high risk of requiring open surgery. This would help in enhanced communication between the surgeon and the patient with respect to the outcome and prognosis. It will be helpful for the surgeons to make a choice of the surgical approach and avoiding laparoscopic surgery in cases where it is unlikely to be successful. Therefore, this study aims to identify such factors which will aid this decision making for the operating surgeon.

Study procedure

Once you have signed the informed consent, necessary personal information and detailed medical history will be taken by the investigator. After this you'll be subjected to imaging (USG/CT) to determine the appendicular diameter and the surgical procedure will be carried out i.e. laparoscopic appendectomy. The surgeries will be performed by surgeons trained in laparoscopy or performed near about 100 laparoscopic procedures.

Potential risks

Nil

Benefits

The benefit of study is to evaluate the outcome of use of suprapubic camera port in laparoscopic appendectomy.

Financial incentive for participation

You will not receive any payment for taking part in this study.

Alternatives

Your participation in this study is entirely voluntary. You are free to refuse to participate or withdraw from the study at any time. You will still receive standard medical care from the hospital. The investigator holds the right to terminate the study at any time

Privacy

To protect my privacy, all the collected information will be given a number rather than using my name. Any information collected during the study will remain confidential. My medical files will be reviewed only at the hospital (or study doctor's office) to check the information and verify the result without breaking my confidentiality.

Authorization to publish results

The information about me will be analyzed together with other study participants. Results of this study will be published and presented to scientific groups for scientific purposes, but I will never be individually identified in the presentation of the study results.

Institutional policy

In case you have any questions related to the study, in future or in case of study related injury or illness, you can contact Principal Investigator, Reg No. BH0121006, Post graduate student Department of General Surgery, KAHER University's J.N Medical College.

Voluntary participation

Your participation in the study is voluntary. In case you need any further information regarding your rights as study participant, you may contact Dr. Harsha Hegde, as Chairman of J. N. Medical College Institutional Ethics Committee on Human Subjects Research, Phone No.0831 2473777 ext-1527 at J. N. Medical College, Belagavi. You are free to stop participation in this study at any time and for any reason.

CONSENT FORM

Study title: **SUPRAPUBIC VS UMBILICAL PORT FOR VISUALIZATION OF APPENDIX IN LAPAROSCOPIC APPENDECTOMY AND TO DETERMINE THE EASINESS OF SURGERY - ONE YEAR PROSPECTIVE CROSS SECTIONAL STUDY.**

- i. I confirm that I have read and understood the information sheet for the above study and have had the opportunity to ask questions.
- ii. I understood that my participation in the study is voluntary and that I am free to withdraw at any time, without giving any reason, without my medical care or legal rights being affected.
- iii. I understood that sponsor of the clinical trial, others working on the sponsor's behalf, the Ethics Committee and the regulatory authorities will not need my permission to look at my health records both in respect of current study and any further research that may be conducted in relation to it, even if I withdraw from the trial. I agree to this access. However, I understood that my identity will not be revealed in any information released to third parties or published.
- iv. I agree not to restrict the use of any data or results that arise from this study provided such a use is only for scientific purposes.
- v. I agree to take part in the above study.

Date:

Subject's name:

Signature / left thumb impression of subject:

Name of person obtaining informed consent:

Signature of person obtaining informed consent:

If a patient has limited ability to read and write, an impartial witness should be present during the entire informed consent discussion and patient's legally acceptable representative should sign on the patient's behalf. In these instances, the patient his/her thumb impression taken in place of signature.

Patient's legally acceptable representative's statement:

I, as the patient's legally acceptable representative was present during the consenting procedure and understand the preceding information describing this study. All of the questions regarding the study and the patient's participation in it have been answered to my satisfaction. I state that all aspects of the study were clearly presented during the consent procedure. The patient is willing to participate in this study and I sign below on his/her behalf testifying to this effect.

Name of the patient:

Name of representative:

Relationship to the patient:

Signature of representative:

Impartial witness declaration:

By signing the consent form, I attest that the information was accurately explained to and apparently understood by the patient and the representative (if applicable) and that the informed consent was freely given by the patient.

Name of impartial witness:

Signature:

Date:

Legal rights: By signing this consent form, we are not waving any of your legal rights.

ANNEXURE- II

PROFORMA FOR DATA COLLECTION

1. I.P.No
2. Name of The Patient:
3. Age:
4. Gender: 1. Male 2. Female
5. Date of admission:
6. Date of discharge:
7. Date of Interview:
8. Address:
9. Phone:
10. Occupation:
 - Unemployed
 - Unskilled
 - Semi-skilled
 - Skilled
 - Professional
11. Education:
 - Illiterate
 - Primary (1st-7th std)
 - High school (8th-10th std)
 - Intermediate
 - Degree and above
12. Socio-economic status:
 - Low
 - Middle
 - High

SCREENING OF PATIENTS

13: H/O Appendicitis:

- YES
- NO

14: H/O any other illness:

- YES
- NO

15: If yes mention,

Data collection instrument:

1. Duration of Pain–

2. Location of pain-

- Right lower quadrant
- Left lower quadrant
- Right upper quadrant
- Left upper quadrant

3. Mode of onset-

- Spontaneous
- Insidious

4. Associated symptoms-

- Fever
- Pain
- Vomiting
- Nausea

5. Medical history:

- Diabetes mellitus
- Hypertension
- Asthma
- CVD

Examination:

1.

Height(cm)	Weight (kg)	BMI

2.

Pulse rate	Blood pressure	Temperature	Respiratory Rate

3. Per abdomen examination

1) Point of tenderness-

Right iliac fossa

- YES
- NO

2) Rebound Tenderness

- YES
- NO

3) Guarding

- YES
- NO

4) Rigidity

- YES
- NO

5) Bowel Sounds

- YES
- NO

➤ Diameter of the appendix on imaging (USG/CT)

- USG
- CT

- **SURGERY:**
- Underwent suprapubic laparoscopic appendectomy:
 - YES
 - NO
- Underwent umbilical laparoscopic appendectomy:
 - YES
 - NO
- Laparoscopic converted to open appendectomy?
 - YES
 - NO

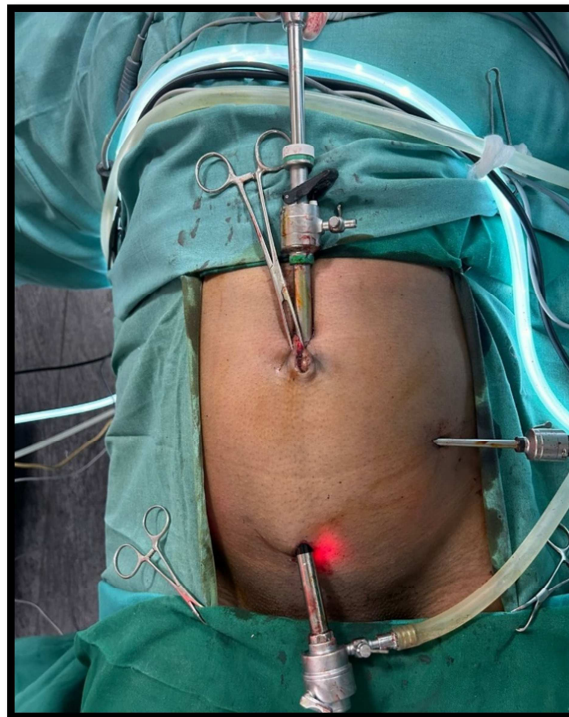
VARIABLES USED IN THE STUDY:

1. Position of appendix
 - a) Retrocaecal
 - b) Subcaecal
 - c) Pelvic
 - d) Pre ileal
2. Time taken for visualization of appendix from the start of surgery.
3. Easiness to trace bowel and ileocaecal Junction:
 - a) Easy
 - b) Hard
4. Ease of dissection of appendix:
 - a) Easy
 - b) Moderate
 - c) Difficult
5. Total operative time for surgery.

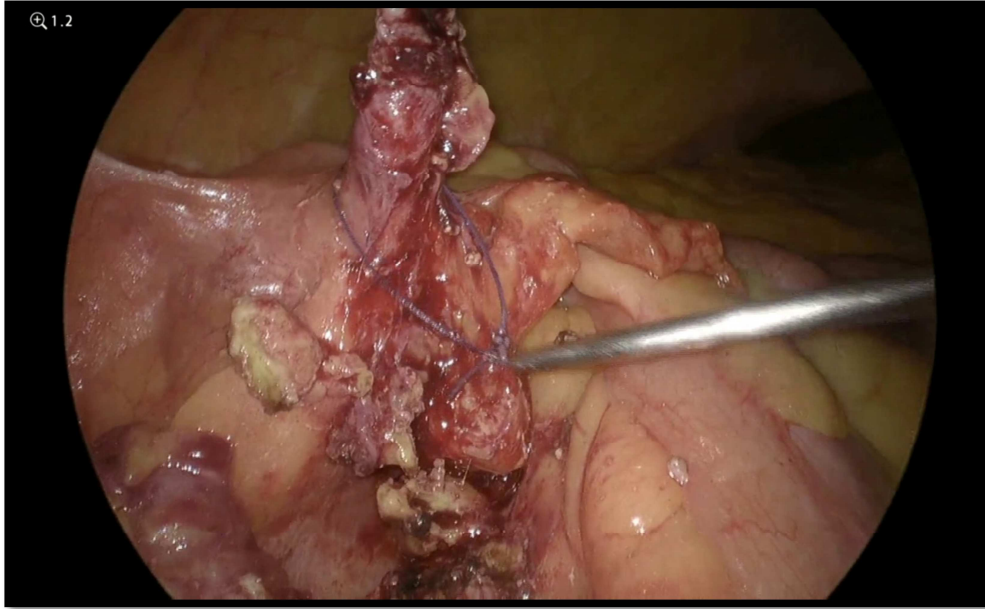
ANNEXURE –III PHOTOGRAPHS



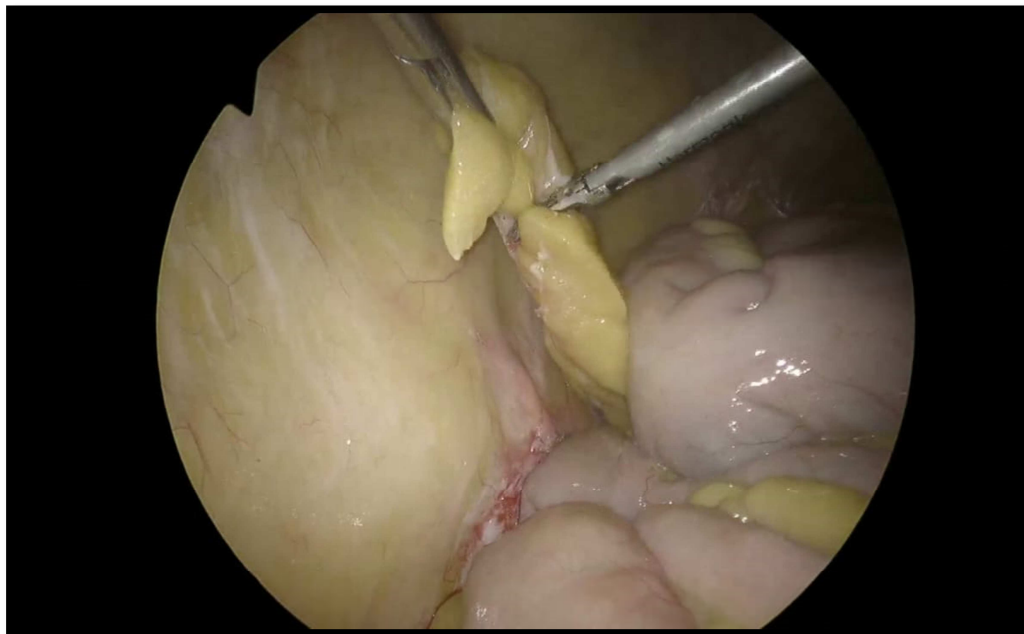
Photograph 1: Showing laparoscopic appendectomy using suprapubic camera port



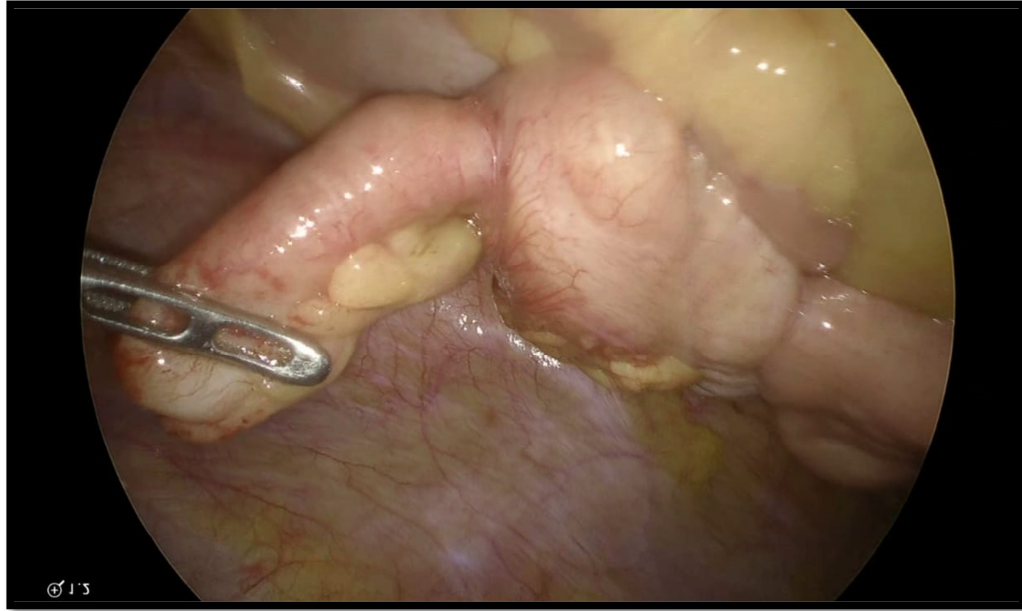
Photograph 2: Showing laparoscopic appendectomy using umbilical camera port



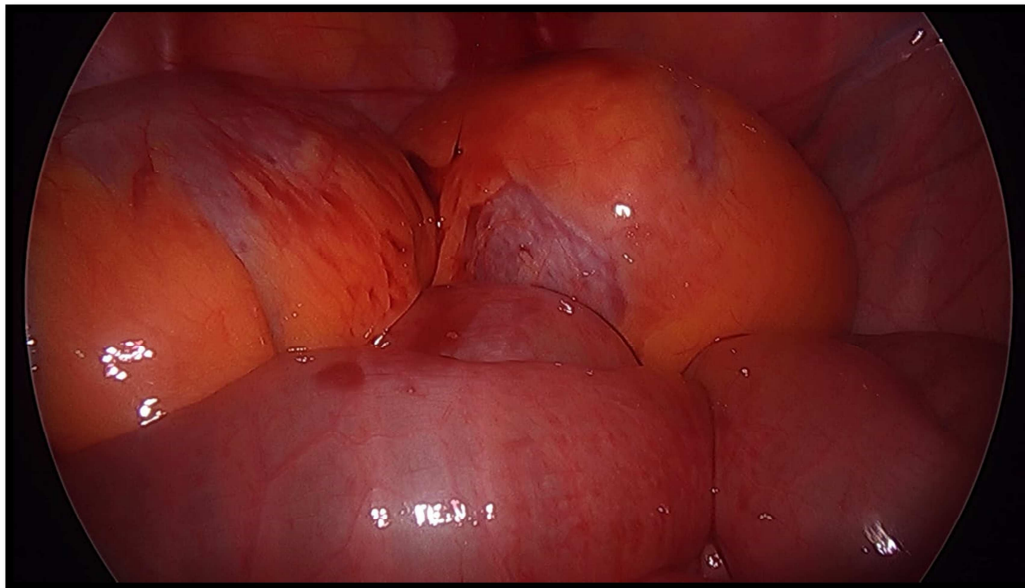
Photograph 3: Showing pelvic position of the appendix



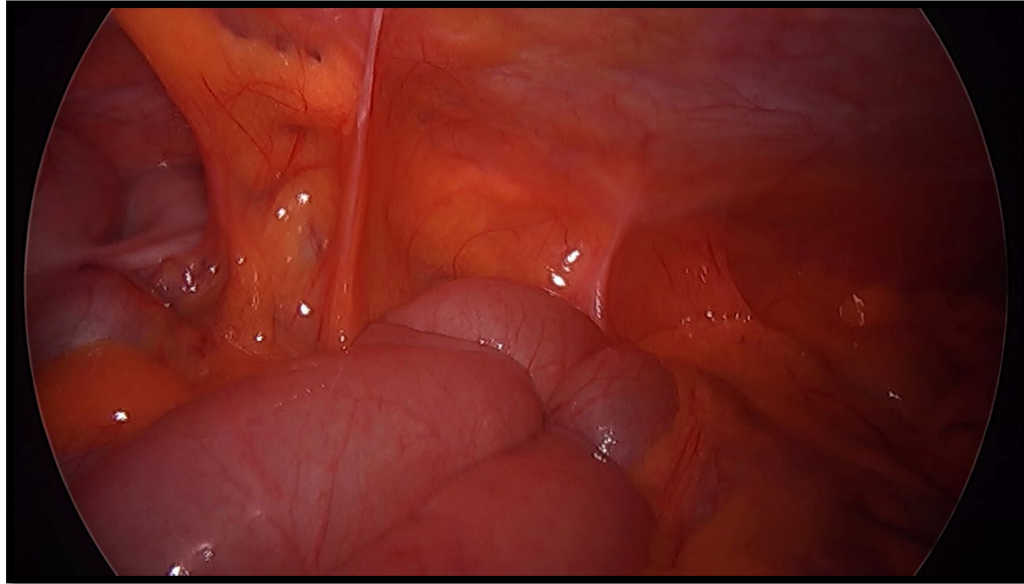
Photograph 4: Showing preileal position of the appendix



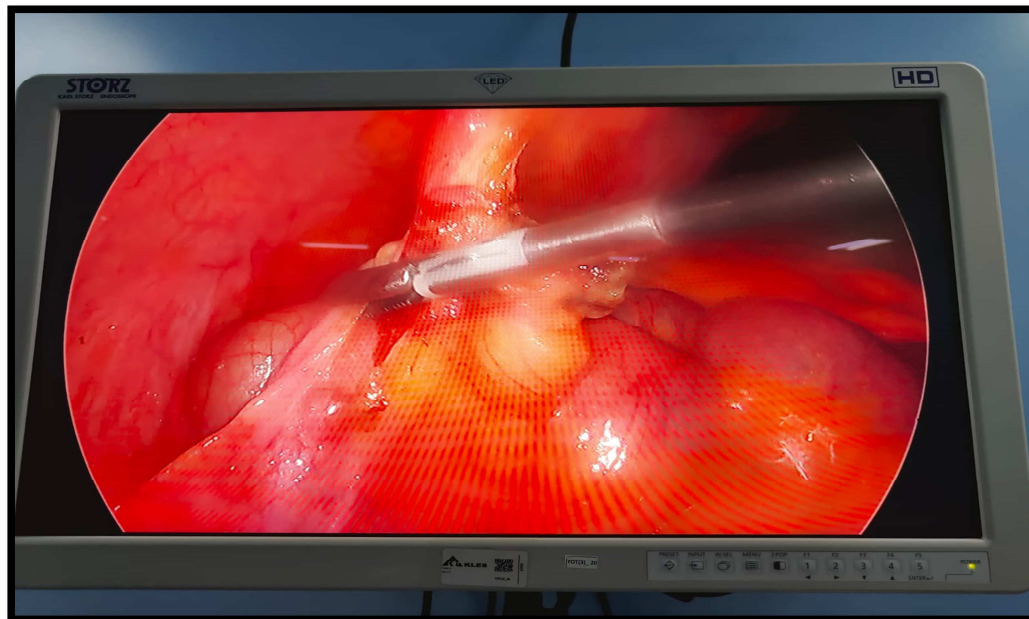
Photograph 5: Showing retrocaecal position of the appendix



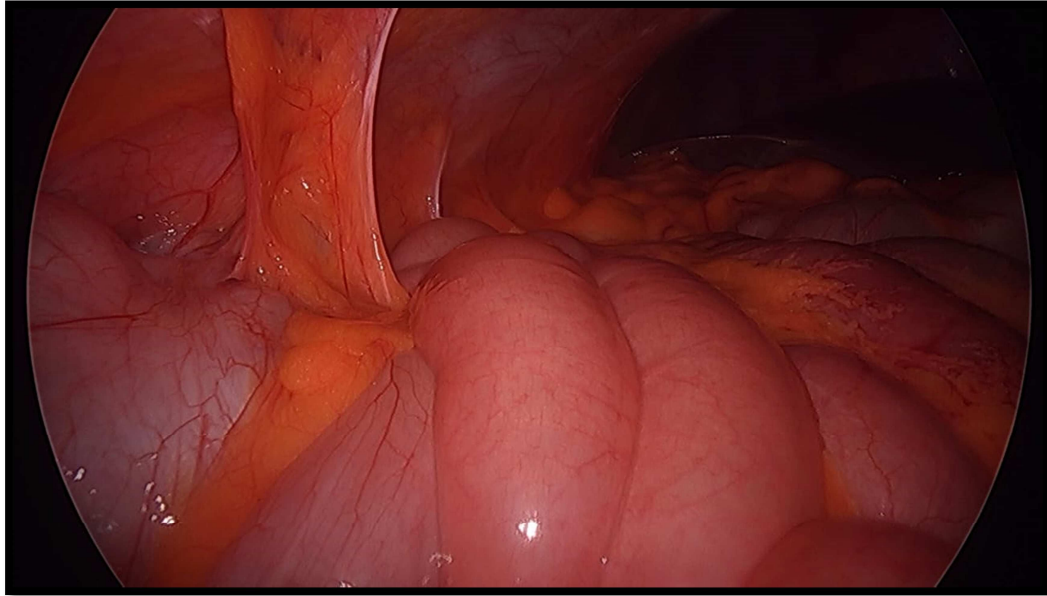
Photograph 6: Showing bowel tracing using the suprapubic camera port



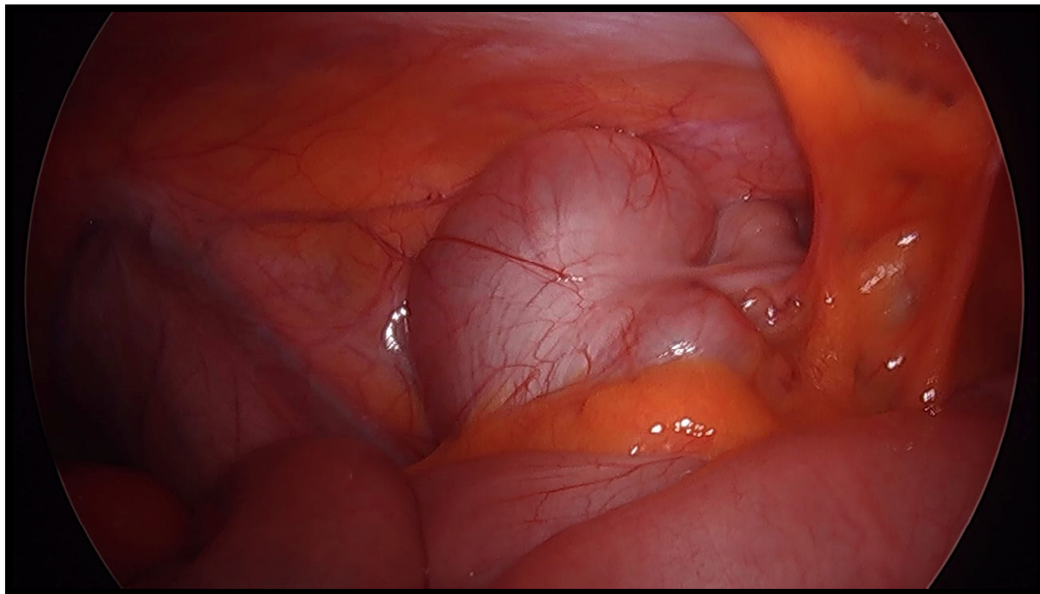
Photograph 7: Showing bowel tracing using the umbilical camera port



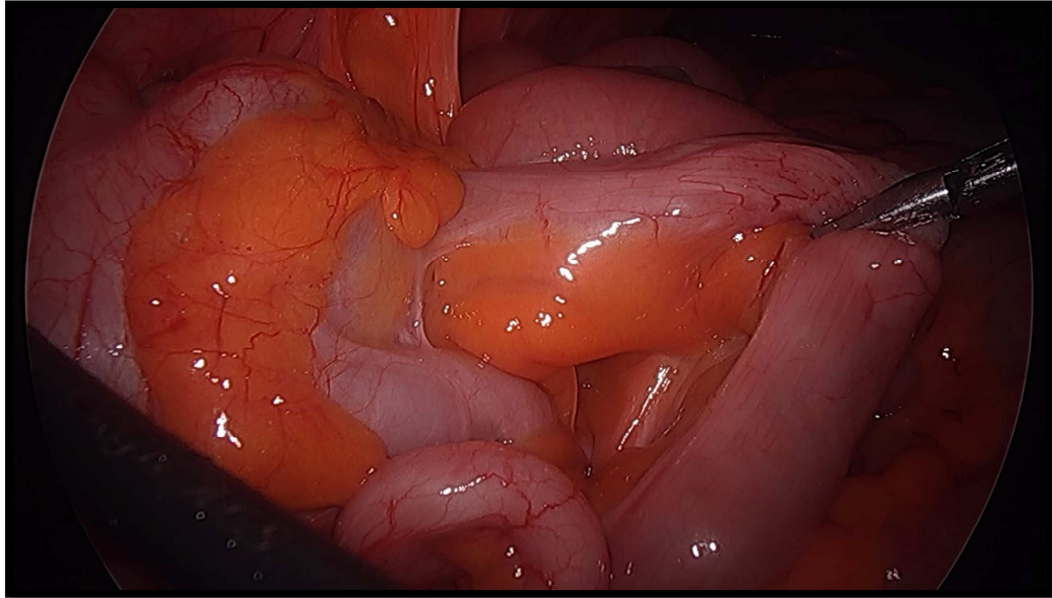
Photograph 8: Showing dissection of mesoappendix



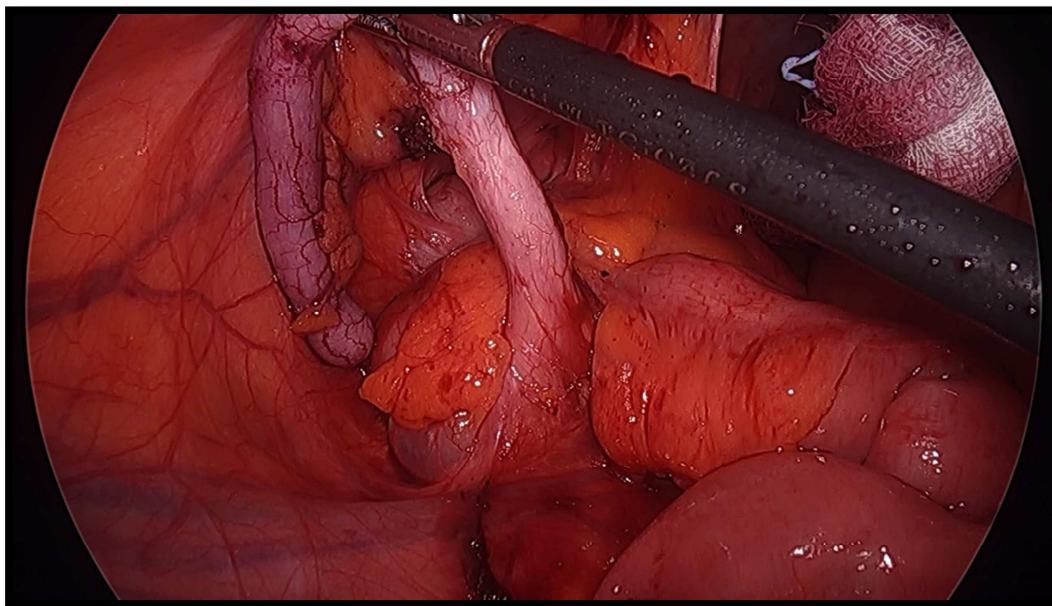
Photograph 9: Showing visualization of the ileocaecal junction and adhesions



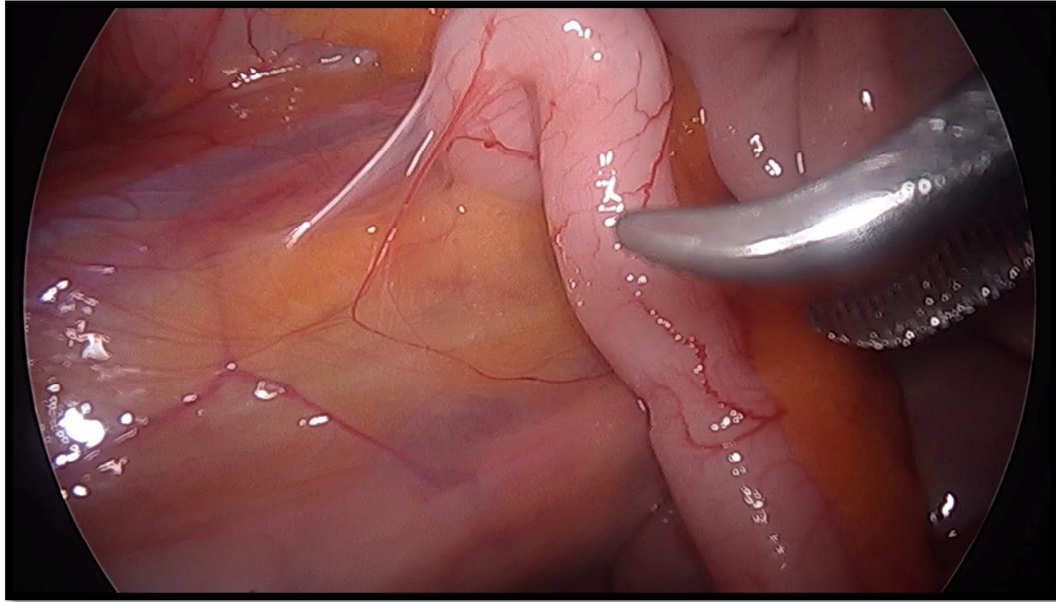
Photograph 10: Showing visualization of the ileocaecal junction using umbilical camera port



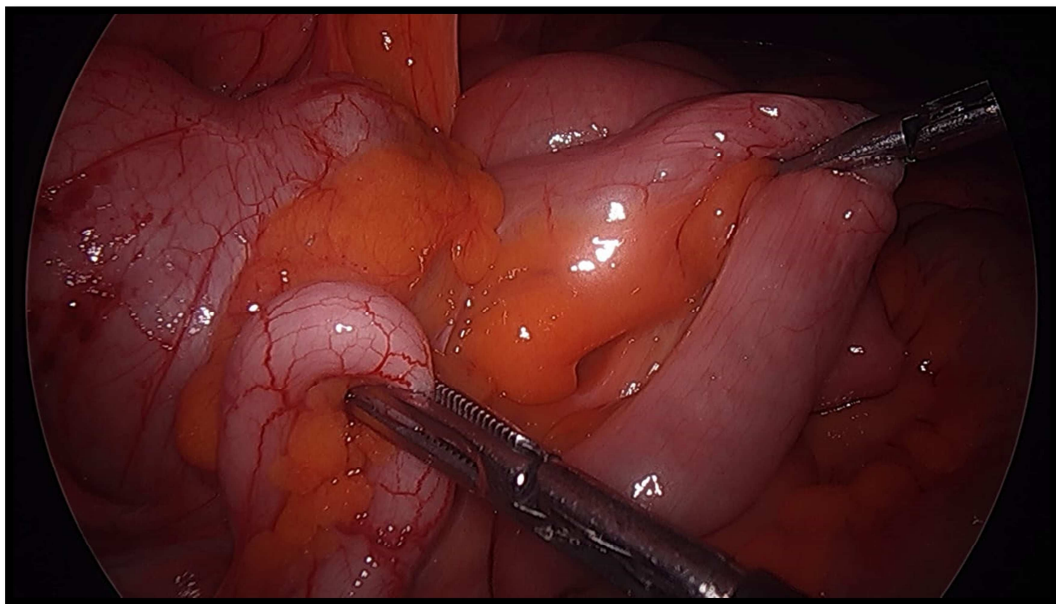
Photograph 11: Showing visualization of the ileocaecal junction using suprapubic camera port



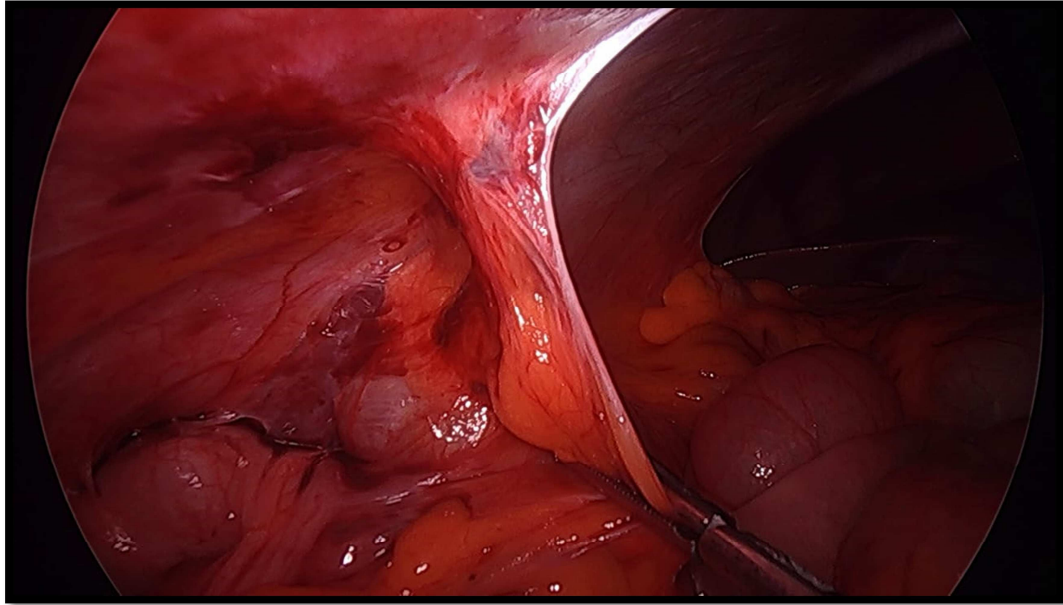
Photograph 12: Showing visualization of the appendix using suprapubic camera port



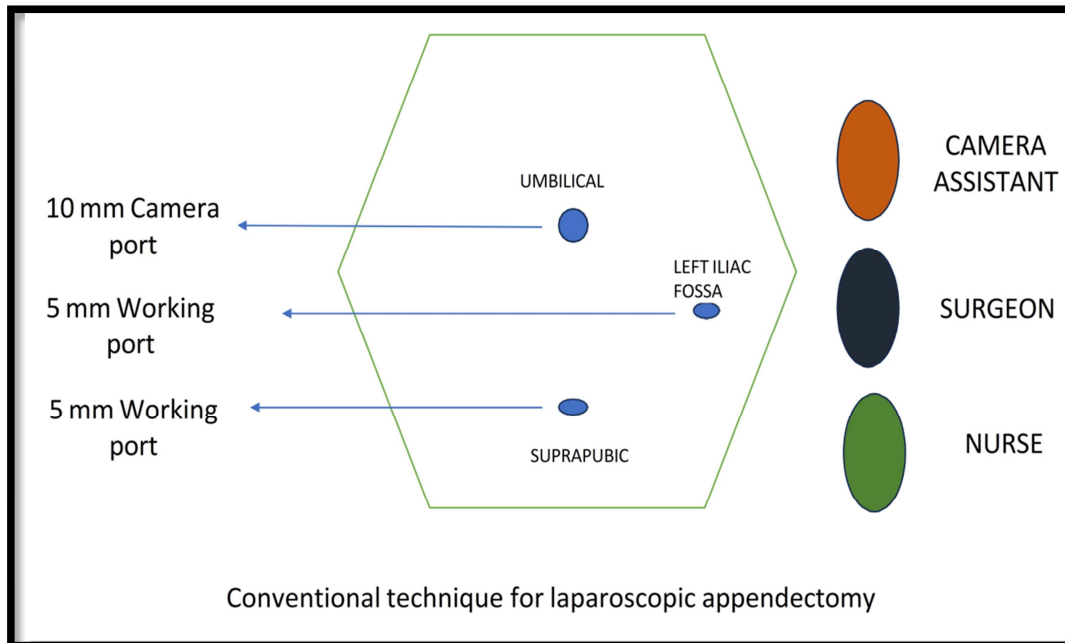
Photograph 13. Showing visualization of the appendix using umbilical camera port



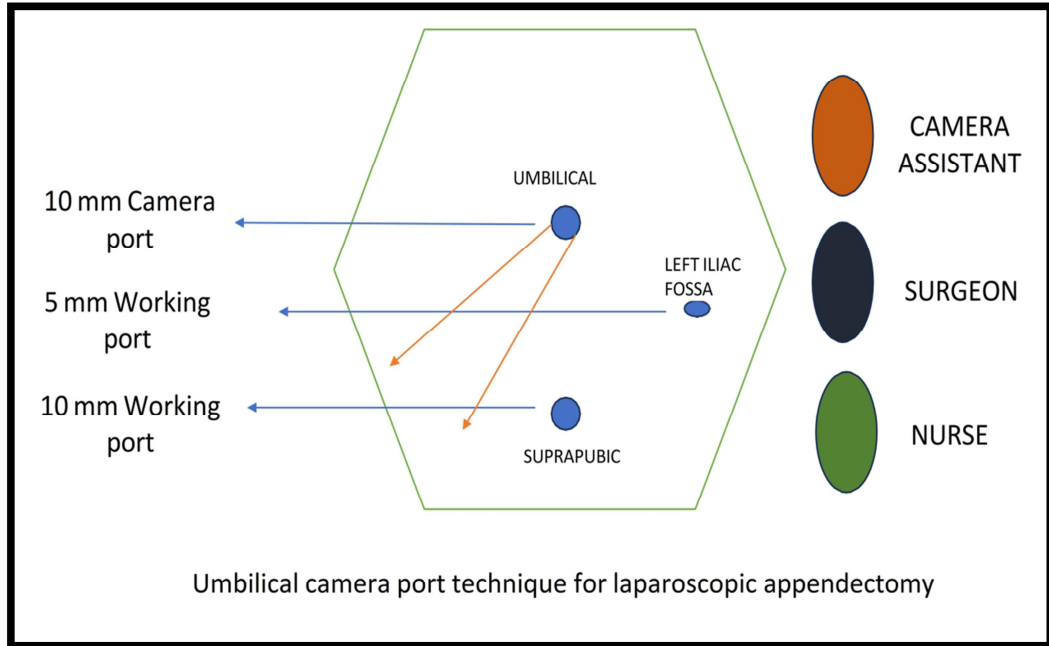
Photograph 14: Showing ease of dissection using umbilical camera port



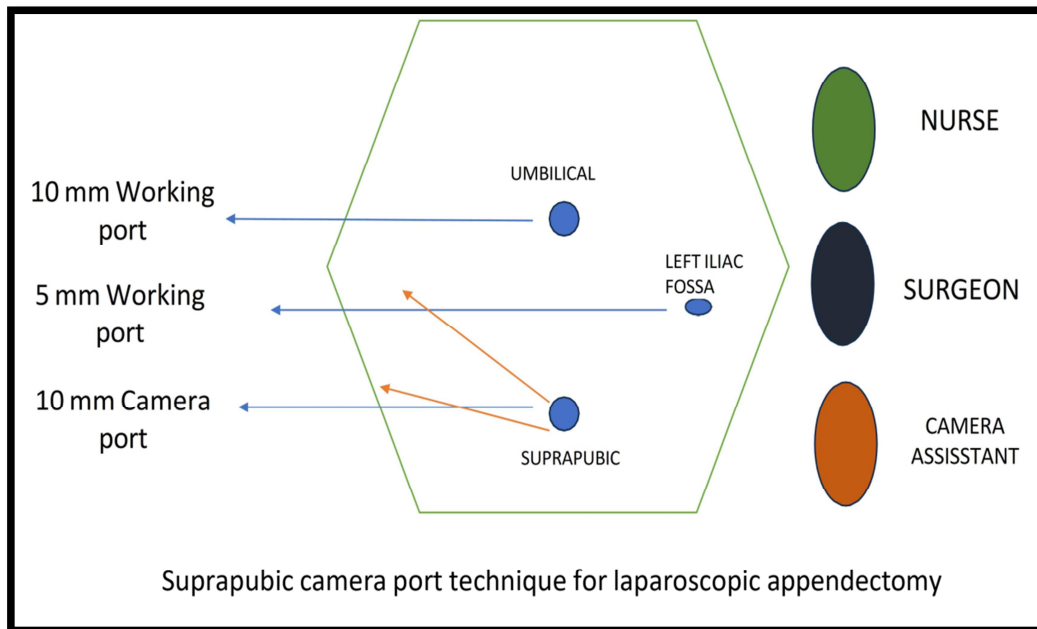
Photograph 15: Showing dissection of the adhesions



Photograph 16: Conventional technique for laparoscopic appendectomy



Photograph 17: Umbilical camera port technique for laparoscopic appendectomy



Photograph 18: Suprapubic camera port technique for laparoscopic appendectomy

ANNEXURE- IV

KEY TO MASTERCHART

Equivalents in the master chart

1. Gender
 - a) Male -0
 - b) Female- 1

2. Position of appendix
 - a) Retrocaecal - 1
 - b) Subcaecal- 2
 - c) Pelvic- 3
 - d) Pre ileal -4

3. Easiness to trace bowel and ileocaecal Junction:
 - a) Easy-1
 - b) Hard-2

4. Ease of dissection of appendix:
 - a) Easy -1
 - b) Moderate-2
 - c) Difficult-3

ANNEXURE- V**MASTER CHART – I****Data of patients using umbilical camera port for laparoscopic appendectomy**

Sr no	IP Number	Age	Gender	Position of appendix	Time taken to visualise appendix (minutes)	Easiness to trace bowel	Ease of dissection of appendix	Time for surgery(minutes)
1	1155086	22	0	Retrocaecal	15.1	1	1	65.1
2	1163643	38	0	Sub caecal	12	1	1	55.3
3	1119756	32	0	Retrocaecal	15.2	2	3	59.4
4	1112368	26	1	Pelvic	9.6	1	2	68.5
5	1129581	40	0	Retrocaecal	15	1	1	65.1
6	1138281	28	0	Sub caecal	14	1	1	63.2
7	1138852	26	0	Retrocaecal	13.8	1	1	63.2
8	1145430	26	1	Retrocaecal	13.9	2	3	65.1
9	1146893	31	0	Pelvic	8.7	1	1	60.7
10	1149360	37	0	Retrocaecal	14.7	1	1	65.1
11	1152325	26	0	Retrocaecal	14.4	1	2	62.3
12	1131422	26	1	Sub caecal	16	1	1	65.1
13	1129430	29	0	Pre ileal	9.5	2	3	60.1
14	1135428	41	0	Retrocaecal	15.3	1	1	65.1
15	1154086	30	0	Retrocaecal	14.2	1	1	72.3
16	1163643	35	1	Pelvic	8.8	1	1	63.2
17	1123456	42	0	Retrocaecal	13.7	1	2	64.4
18	1143563	36	0	Pelvic	9.1	2	3	63.2
19	1165473	27	1	Retrocaecal	15	1	1	61.7
20	1198345	33	0	Sub caecal	14	1	1	73.2
21	1123786	26	0	Retrocaecal	15.4	2	3	66.3
22	1134982	26	1	Retrocaecal	15.2	1	1	73.1
23	1176384	39	0	Pre ileal	10.7	1	1	65.1
24	1134982	58	1	Retrocaecal	13.9	2	3	68.5
25	1135628	56	0	Retrocaecal	13.5	1	1	73.6
26	1172934	54	1	Pelvic	8.4	1	2	71.8
27	1156372	53	0	Retrocaecal	14.9	2	3	65.1
28	1128394	58	1	Pelvic	9	2	3	74.1
29	1192763	52	0	Retrocaecal	14.8	1	1	60.3
30	1140023	60	1	Retrocaecal	14.2	1	1	69

Data of patients using suprapubic camera port for laparoscopic appendectomy

Sr no	IP number	Age	Gender	Position of appendix	Time taken to visualise appendix (minutes)	Easiness to trace bowel	Ease of dissection of appendix	Time taken for surgery (minutes)
1	1145387	21	0	Sub caecal	9.8	1	1	62.4
2	1145956	51	1	Retrocaecal	9.8	1	1	53.1
3	1112357	24	0	pelvic	10.1	1	1	60.8
4	1149554	22	1	Retrocaecal	9.7	1	1	63.5
5	1119549	25	1	Pre ileal	10.5	2	3	62.3
6	1135439	26	0	Retrocaecal	10.5	1	1	57.2
7	1119562	58	1	Sub caecal	10.2	1	1	59.4
8	1143592	32	0	Retrocaecal	11	1	1	54.6
9	1141256	24	1	pelvic	12	2	3	58.7
10	1138080	36	1	Retrocaecal	9.6	1	1	55.9
11	1138096	51	1	Retrocaecal	10.3	1	1	59.2
12	1124943	33	0	Retrocaecal	10.2	1	1	61.4
13	1124948	45	0	Sub caecal	12	1	1	46.8
14	1124956	42	1	Retrocaecal	10	1	1	58.3
15	1136019	59	1	pelvic	11.5	2	2	55.1
16	1157142	34	0	Retrocaecal	10.4	1	1	61.9
17	1123765	54	1	Retrocaecal	10.2	1	1	56.2
18	1198365	45	0	Retrocaecal	10	1	1	60.7
19	1180234	43	0	pelvic	11.5	2	3	47.5
20	1177343	28	1	Retrocaecal	9.8	1	1	63.2
21	1100348	56	0	Sub caecal	8	1	1	56.8
22	1124089	34	1	Retrocaecal	10.3	2	2	61
23	1123067	47	1	Retrocaecal	10.5	1	1	56.9
24	1134002	55	0	Pre ileal	12.1	2	3	61.1
25	1123045	41	1	Retrocaecal	10.1	2	1	60.3
26	1100340	36	0	Retrocaecal	10.2	1	1	57.8
27	1177672	29	1	Retrocaecal	9.9	1	1	50.2
28	1124876	54	0	Retrocaecal	10	2	1	64.5
29	1141378	34	0	Retrocaecal	9.8	1	1	65.2
30	1100012	57	1	Retrocaecal	10.2	1	1	57.9