"CONVENTIONAL LAPAROSCOPIC APPENDECTOMY VERSUS DOUBLE INCISION THREE PORT LAPAROSCOPIC APPENDECTOMY: A ONE YEAR RANDOMIZED CONTROLLED TRIAL AT KLE'S DR. PRABHAKAR KORE HOSPITAL & MRC, BELAGAVI"

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ENDORSEMENT BY THE HOD/PRINCIPAL/ HEAD OF THE INSTITUTION

This is to certify that the dissertation entitled **"CONVENTIONAL LAPAROSCOPIC APPENDECTOMY VERSUS DOUBLE INCISION THREE PORT LAPAROSCOPIC APPENDECTOMY: A ONE YEAR RANDOMIZED CONTROLLED TRIAL AT KLE'S DR. PRABHAKAR KORE HOSPITAL & MRC, BELAGAVI"** is a bonafide research work done by **(REG. NO. BH0114005).**

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LIST OF ABBREVIATIONS USED

^{0}F	Degree Fahrenheit
AA	Acute Appendicitis
AnCA	Acute on Chronic Appendicitis
AP	Abdominal Pain
BP	Blood pressure
CA	Chronic Appendicitis
CLA	Conventional Laparoscopic Appendectomy
CT	Computerized Tomography
cm	Centimeters
CO_2	Carbon dioxide
CRP	C-reactive protein
DC	Differential count
DILA	Double Incision Three Port Laparoscopic Appendectomy
DILS	Double Incision Three Port Laparoscopic Surgery
ECG	Electrocardiogram
gm	Gram
H2O	Water
Hb	Haemoglobin
HCG	Human chorionic gonadotropin
i.e.	That is
IP. No.	In patient number
Kgs	Kilograms
LA	Laparoscopic Appendectomy
LESS	Laparoendoscopic Single Site Surgery

LIF	Left iliac fossa
Min	Minimum
mm Hg	Millimeter of mercury
mm	Millimeters
NOTES	Natural Orifice Transluminal Endoscopic Surgery
n	Total number
OA	Open Appendectomy
OR	Odds Ratio
RCTs	Randomized controlled trials
RIF	Right iliac fossa
RR	Respiratory rate
SD	Standard deviation
SE	Subcutaneous Emphysema
SILS	Single Incision Laparoscopic Surgery
SPL	Single Port Laparoscopy
SSI	Surgical Site Infection
TC	Total count
US	United States
VAS	Visual Analogue scale
Vs	Versus
WBC	White blood cell

ABSTRACT

INTRODUCTION:

The Management of appendicitis has evolved dramatically in the last 120 years, from McBurney's large incision, to minimally invasive Laparoscopic appendectomy (LA), to hardly noticeable incisions with Single Incision Laparoscopic Surgery (SILS). As a bridge between conventional laparoscopic surgery and single incision laparoscopic surgery (SILS), double incision laparoscopic surgery (DILS) further minimize the invasiveness of laparoscopic surgery by reducing the number of incisions. The present study was an attempt to establish the efficacy of Double incision three port laparoscopic Appendectomy as an alternative to Conventional Three-port Laparoscopic Appendectomy

METHODOLOGY:

This one year randomized controlled trial was done in the Department of General Surgery, KLES Dr. Prabhakar Kore Hospital and Medical Research Centre, Belagavi from January 2015 to December 2015. A total of 60 patients were divided into two groups, Group A (Conventional laparoscopic appendectomy) and Group B (Double incision three port laparoscopic appendectomy).

RESULTS:

There was no significant difference regarding operative time between the two groups. Post-operative stay and post-operative pain were similar in both the

groups, however, patients in the double incision three port laparoscopic appendectomy group were more satisfied with their cosmetic outcome (P =0.04).

CONCLUSION:

Double incision three port laparoscopic appendectomy can be performed with acceptable operative outcomes which is equivalent to conventional laparoscopic appendectomy with superior cosmetic results.

Keywords

Appendicitis, Laparoscopic appendectomy, Double incision laparoscopic appendectomy, Minimal invasive surgical procedures

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INTRODUCTION

The vermiform appendix is a vestigial organ in humans. Its propensity for inflammation, results in the clinical syndrome known as **Acute Appendicitis[1].**

Reginald Fitz from Boston was the first person to identify appendix as cause of right iliac fossa pain and coined the term Appendicitis. 130 years later appendicitis is still the most common abdominal emergency with appendectomy being the treatment of choice. It is often the first major procedure performed by a surgeon in training. The diagnosis of appendicitis remains essentially clinical even with the advent of modern diagnostic tools[1].

The life time risk of appendicitis is 8.6% for male and 6.7% for females. Because of delay in the diagnosis and the presence of co-morbid conditions infants and the elderly have increased number of complications.

However regardless of what frequency it occurs, appendicitis is a mysterious disease despite our best efforts remains the most commonly, misdiagnosed surgical emergency[2].

The surgical management of appendicitis over the years has advanced from open techniques to minimally invasive techniques. Now, Laparoscopic Appendectomy is the gold standard of treatment even for complicated appendicitis[3,4].

Patients undergoing laparoscopic appendectomy (LA) experience reduced wound infections, require less intra-operative and postoperative analgesia with reduced hospital stay and quick return of normal bowel function avoiding a large laparotomy scar. Intra-abdominal abscesses, higher costs and lengthy operative time are some of its disadvantages[5,6,7].

Although the surgical technique of laparoscopic appendectomy has been well established, efforts are still being made to decrease abdominal incision and visible scars by single incision laparoscopic surgery (SILS) with use of special multiport umbilical trocar. However, this technique needs specialized instruments and adds a financial burden. Thus, limiting its widespread use especially in rural/peripheral centres with limited resource[7,8].

Recent advance in minimally invasive surgery is, Natural Orifice Trans-luminal Endoscopic Surgery (NOTES) which requires specialized instruments, but there are numerous complications associated with it like hollow viscus perforation and failed sutures. Cost-benefit analysis with this procedure is still to be evaluated[9,10]. The conventional three-port LA (CLA) has proven its worth in the management of Appendicitis.

From a cosmetic viewpoint, third port scar in the right or left iliac fossa is the only visible sign of surgery as umbilical and supra-pubic port scars are hidden by natural camouflages. The double incision three port laparoscopic appendectomy (DILA) technique avoids the third trocar scar. Compared to newer modalities i.e., SILS and NOTES, there is no need for expensive specialized equipment. Till date no randomized studies have been done comparing reduced port technique with standard multiport procedures, potential benefits and advantages over multiport have not yet been proven. It appears that these two techniques, conventional laparoscopic appendectomy and double incision three port laparoscopic appendectomy have similar outcomes, but an randomized control trial (RCT) is required to compare the two techniques.

In this study we assess the efficacy of Double incision three port laparoscopic Appendectomy as an alternative and equivalent to Conventional Three-port Laparoscopic Appendectomy.

AIM AND OBJECTIVES

AIM:

To establish the efficacy of Double incision three port laparoscopic Appendectomy as an alternative to Conventional Three-port Laparoscopic Appendectomy.

OBJECTIVES:

Comparison of the two techniques of laparoscopic Appendectomy with regards to:

Primary

To compare the duration of surgery between conventional laparoscopic appendectomy and double incision three port laparoscopic appendectomy

Secondary

To compare the following outcomes between conventional laparoscopic appendectomy and double incision three port laparoscopic appendectomy groups;

1. Post operative pain
2. Cosmetic outcome

REVIEW OF LITERATURE

ANATOMY OF THE APPENDIX

Embryology and Development

Caecum and appendix develop from the midgut i.e., from the post arterial segment (superior mesenteric artery) of the midgut loop. During eighth week of intrauterine development the caecum gives a protruberance at its end which is the first visibility of the appendix. The proximal part of the bud grows rapidly to form caecum while the distal part remains narrow and forms the appendix.

Subsequently, the lateral (right) wall of caecum grows much more rapidly than the medial (that is left) so that the point of attachment of appendix comes to be on the medial side. There are various abnormalities in the development of appendix, the caecum may retain its foetal form with an apical (vermiform) appendix[11].

In cases of midgut malrotation and situs inversus, the caecum will not be located in the usual right lower quadrant. Small bowel and proximal colon incompletely rotate or fail to rotate around the axis of the superior mesenteric artery in malroration of midgut, so appendix will remain in the left upper quadrant of abdomen. Situs inversus is a rare autosomal recessive congenital defect with transposition of abdominal and/or thoracic organs[11].

The appendix is longer in children than in adults, its length varies from 2 cm to 20 cm, with an average of 9 cm[12].

The lumen of the appendix communicates with the caecum by an orifice which is below and behind the ileocaecal opening. The orifice is sometimes guarded by a semilunar valve which is formed by a fold of mucous membrane.

The normal appendix luminal capacity is about 0.1 ml. i,e., there is no real lumen. The intraluminal pressure increases to about 60 cms of water even with secretions as little as 0.5ml.

Position of Appendix

The vermiform appendix is a narrow worm shaped tube which springs from the postero-medial wall of the caecum. It may occupy one of the several following positions:[13]

1) Retrocaecal Appendix : Behind the caecum and lower part of ascending colon.
2) Pelvic Appendix : crosses the pelvic brim and lies in true pelvis.
3) Subcaecal Appendix : Below the caecum.

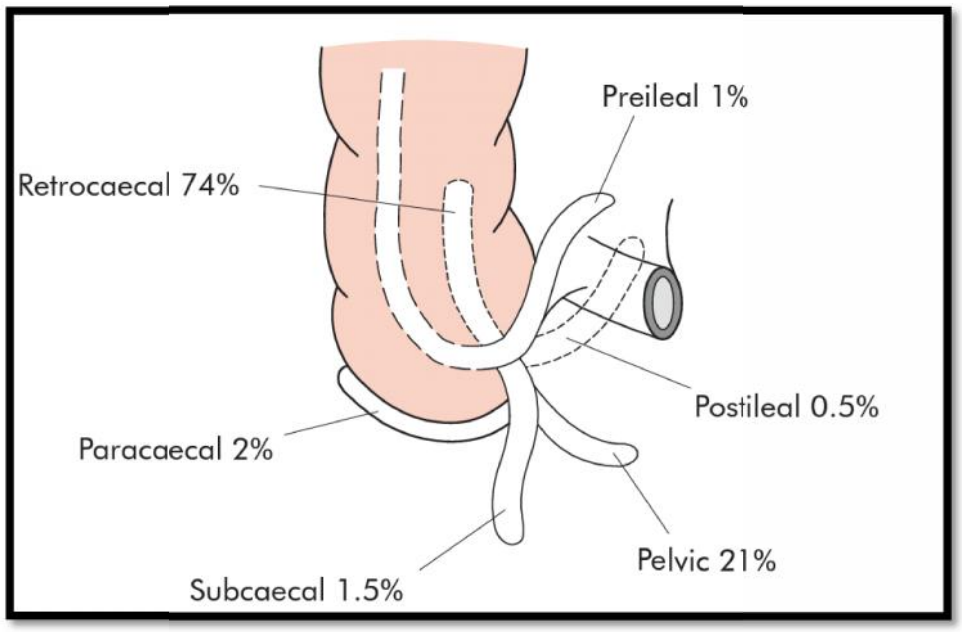


Fig 1 : Positions of appendix[13]

4) Paracaecal : lies on right side or left side of caecum.
5) Preileal : In front of terminal part ileum and may then be in contact with anterior abdominal wall.
6) Postileal : Behind the terminal part of the ileum.

Mostly, it is retrocaecal and the next common position is pelvic followed by paracaecal, subcaecal, preileal, and postileal in descending order.

The three taenia coli of ascending colon and caecum converge at the base of the appendix where they merge into longitudinal muscular layer of appendix. The anterior taenia of caecum is generally distinct and can be easily traced to the base of appendix.

Mesoappendix is the fold of the peritoneum, triangular in shape, which suspends the appendix close to the ileocaecal junction. The blood vessels, nerves and lymph vessels of the appendix are enclosed in its layers[13].

Blood Supply

The ileocolic artery is a branch of superior mesenteric artery which supplies the following branches.

(a) ascending (colic) artery which passes upwards on the ascending colon;

(b) anterior and posterior caecal artery, distributed to the front and back of the caecum;

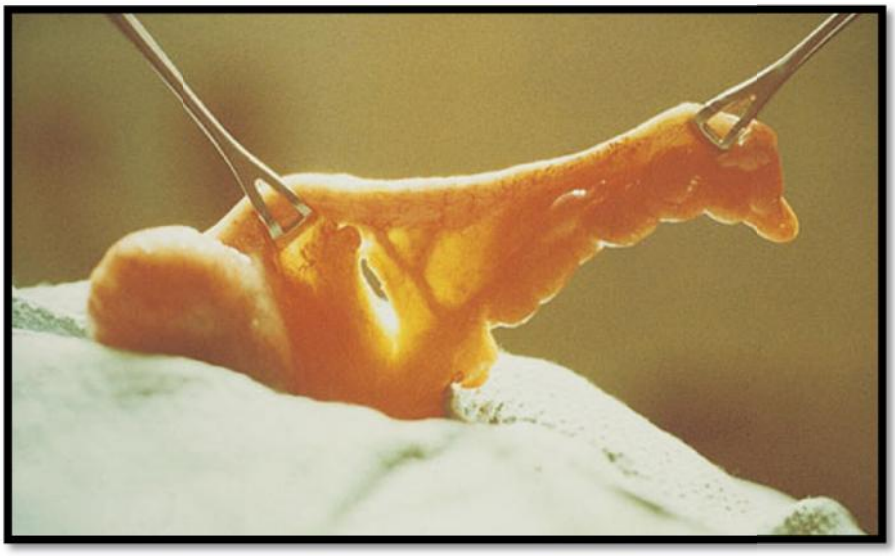


Fig 2 : Arterial supply of appendix [13]

(c) The appendicular artery descends behind the termination of the ileum and enters the mesoappendix, it runs at first close to and later in the free margin of the mesoappendix, but its terminal part is in actual contact with the appendicular wall.

(d) ileal artery ends by anastomosing with the termination of the superior mesentric artery.

A number of accessory arteries are common, especially, the artery described by SESHACHALAM which is an accessory appendicular artery[14].

Venous drainage

Venous drainage is to appendicular, ileocolic and superior mesenteric veins which further drain to the portal vein[15].

Lymphatic drainage

The lymphatics drain into the anterior ileocolic lymph nodes. Efferent lymphatics vessels pass to the superior mesenteric lymph nodes.[15]

Nerve supply

A plexus of nerves consisting of both sympathetic and parasympathetic fibres accompany the arteries to reach the caecum and appendix. The plexus is an offshoot from the superior mesenteric plexus. The sympathetic fibres are derived from T10 – T11 segment of the cord and the parasympathetic fibres are derived from vagi.[15]

Structure (Histology)

Vermiform appendix consists of the following coats:

1) Serous 2) Muscular 3) Submucous 4) Mucous

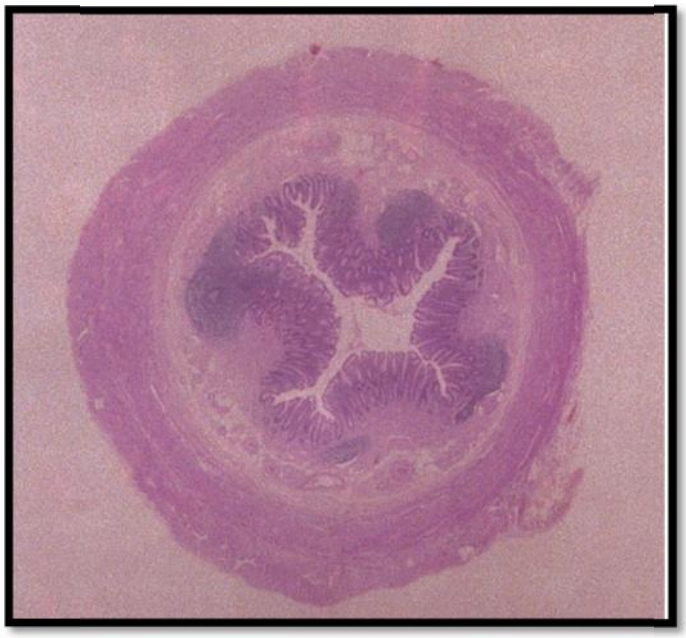


Fig 3 : Normal Histology of vermiform appendix[13]

The serous coat forms a complete investment of the tube, except along the narrow line of attachment of mesentery. A layer of sub-serous areolar tissue lies beneath it. The longitudinal muscular fibers form a uniformly thick layer investing the appendix, except at one or two points where both the longitudinal and circular fibers are deficit.

At the base of appendix the longitudinal muscle becomes thickened at three points to form incipient taenia coli which becomes continuous with those of colon. The circular muscular fiber forms a thicker layer than longitudinal fibers; submucous coat was well developed and contains large number of masses of lymphoid tissue.

The mucous membrane was lined with columnar epithelium, but intestinal glands are fewer in number and penetrate deeply among lymphoid tissue[12].

Surface Anatomy

The surface marking commonly used for the base of the appendix is the junction of the lateral and middle thirds of the line joining the right anterior superior iliac spine to the umbilicus (McBurney's point).

Epidemiology

In the UK alone, approximately 40,000 appendectomies are performed every year. Although appendectomy is a routine surgical procedure with low mortality, 5–28 per cent of patients develop a complication[16,17].

The peak incidence of appendicitis occurs in the first and second decade of life, while it is infrequent to deal with appendicitis in children younger than 5years of age[18] but in recent years, the number of patients aged 30-69 has increased to 6.3%[19].

In Asia and Africa, there is a lower incidence of appendicitis. In people consuming dietary fibre there is decreased faecal viscosity, decreased bowel transit time and reduced faecolith formation. These factors predispose to the obstruction of the appendiceal lumen[20].

Etiology and Pathogenesis of Appendicitis and its Complications

The dominant etiological factor in acute appendicitis is obstruction of appendiceal lumen. Faecoliths are the most common cause of appendiceal lumen obstruction. Other causes are inspissated barium from x-ray studies, lymphoid hypertrophy, intestinal parasites and vegetable and fruit seeds, tumors, more severe the inflammatory process, higher the chances of obstruction. Faecoliths and calculi are found in 40% of cases of acute appendicitis[21].

The sequence of events leading to perforation of appendix is predictable. Obstruction of the appendiceal lumen proximally with continuing normal secretions by mucosa of appendix lead to closed loop obstruction causing distension and multiplication of resident bacteria in appendix resulting in reflex nausea, vomiting, and visceral pain. Appendiceal distension further stimulates the nerves i.e visceral afferent fibers over appendix stretch producing vague, dull, diffuse pain in the umbilical region[11].

As the appendiceal pressure increases, the venous pressure is increased. Capillaries and venules of appendix are occluded, but not the arterioles, which results in engorgement and congestion of appendix. The inflammation then involves the appendiceal serosa and parietal peritoneum in the region, producing a characteristic shift in pain from umbilicus to the right iliac fossa[11].\

Bacterial invasion is allowed due to impaired blood supply to the mucosa of appendix. As the venous and arterial supply is hampered due to progressive distension, the poorest vascular area is the most affected: the antimesenteric border develop infarcts. Bacterial invasion, distension, compromise of blood supply, and infarction lead to perforation of the infarcted area. Perforation of appendix generally occurs beyond the point of obstruction rather than at the tip due to intraluminal tension[11].

Spontaneous reduction of acute episodes of appendicitis can occur. Previous history of similar complaints, but lesser in severity can be elicited from patients who are found to have acute appendicitis. Old, healed acute inflammation is correlated with thickening and scarring in the histopathological examination of removed appendices[11].

In few cases localization of perforation by greater omentum and dilated ileum with suppuration lead to formation of appendicular abscess. When there is no pus inside it forms a appendicular mass. Collection of mucus inside the lumen of appendix leads formation of mucocele of appendix[11.]

Microscopy in acute appendicitis

The mucosa is edematous, hyperemic, infiltrated with polymorphonuclear leucocytes and in places with necrosis. There is also polymorphs infiltration seen in submucosa and muscularis. The lymphoid follicles are hyperplastic and necrotic.

The blood vessels on the serosa are often congested and dilated with fine fibrous fibrinous exudate. Usually, a localized part in the wall is completely necrotic. The fibro-adipose tissue of the mesoappendix is usually edematous and hyperemic

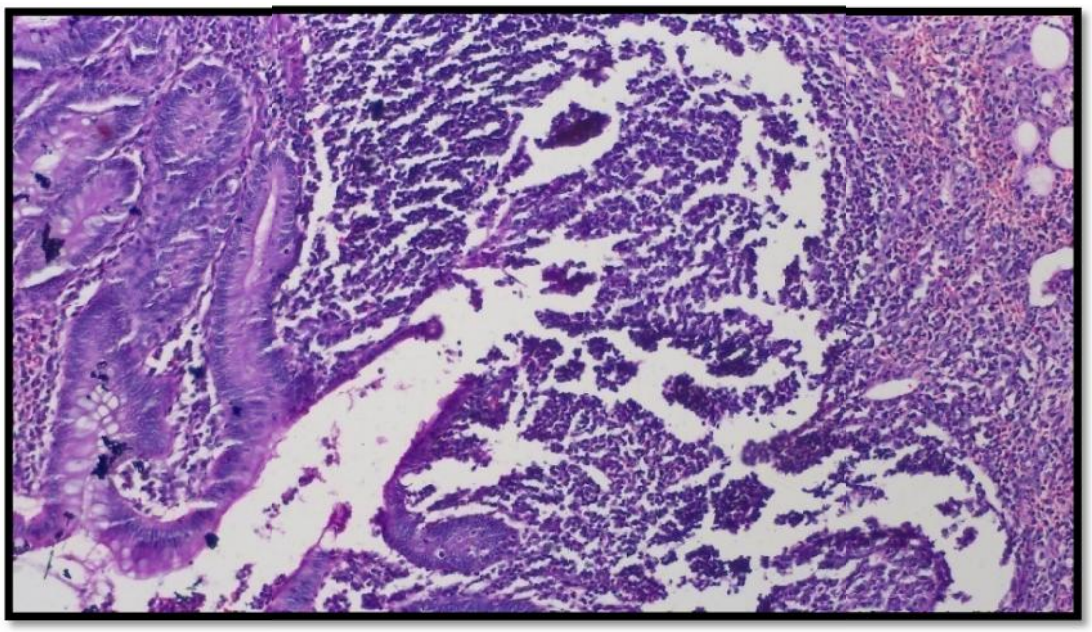


Fig 4 : Histology of Acute Appendicitis

Bacteriology

Bacterial flora of normal appendix and the colon are similar. Except Porphyromonas gingivalis, the flora remain constant lifelong. Colonic infections such as diverticulitis have the same bacterial cultures as appendicitis. Escherichia coli and Bacteroides fragilis are the most common organisms found in appendicitis. Other bacteria present in this condition are other anaerobic and facultative bacteria along with mycobacteria. Some series have reported culture of up to 14 different organisms in patients with perforation as appendicitis is a polymicrobial infection[11].

Common Organisms Seen in Patients with Acute Appendicitis

Aerobic and Facultative	Anaerobic
Gram-negative bacilli	*Gram-negative bacilli*
Escherichia coli	Bacteroides fragilis
Pseudomonas aeruginosa	Other Bacteroides species
Klebsiella species	Fusobacterium species
Gram-positive cocci	*Gram-positive cocci*
Streptococcus anginosus	Peptostreptococcus species
Other Streptococcus species	Gram-positive bacilli
Enterococcus species	*Clostridium species*

Clinical features

A detailed history and a thorough physical examination is necessary in the diagnosing acute appendicitis. The common chief complaint of patients with appendicitis is abdominal pain. Murphy was the first to describe the colicky type of abdominal pain[22].

The course of pain is initially peri-umbilical followed by movement of the pain to the right iliac fossa[23]. This classical presentation of acute appendicitis pain is seen only in only 50% of patients[24].The reason behind this shift of pain from umbilicus to right iliac fossa is that, initially visceral pain is felt due to obstruction and distension of appendix which is poorly localized at the umbilicus and later when the inflamed appendix touches the parietal peritoneum, somatic pain is felt over the right iliac fossa. Other associated symptoms include loss of appetite and nausea. Profuse vomiting is a uncommon feature of appendicitis and if present indicates the development of diffuse peritonitis. Some patients may have a low grade fever with a range of bowel habit disturbances[22].

Those patients at the extremes of age present a diagnostic challenge as they present with atypical signs and symptoms. In Infants under 36 months of age appendicitis is rare. Nonfocal findings such as irritability and anorexia may be present. In elderly fever is uncommon but perforation rate is high[25]**.**

Examination

The patient presents with features of an inflammatory response. They usually have a low grade fever with associated tachycardia, and appear flushed. Movement and coughing exacerbates the pain, so the patient will often lie still.

On palpation of abdomen, the maximum site of tenderness is at or near the McBurney's point[22]. The patient may show signs of peritoneal irritation with localized guarding and muscular rigidity or rebound tenderness[26].

Other important signs seen in appendicitis are :-

ROVSING sign: named after Niels Rovsing, palpation in the left iliac fossa results in pain in the right iliac fossa[23].

PSOAS sign: The psoas muscle can be irritated by an inflamed appendix and movement of this muscle can result in pain. Elevation and extension of leg against resistance causes pain in case of retrocecal appendicitis[23].

OBTURATOR sign: results from irritation of the obturator muscle. Flexion and internal rotation of right hip causes pain indicative of pelvic appendicitis[23].

Findings on rectal or vaginal examination may be normal although pain on rectal examination may indicate a pelvic appendix. A rectal examination is part of a thorough assessment of the patient with acute abdominal pain, however, the value of rectal examination in the diagnosis of appendicitis is debatable. In the presence of tenderness and guarding in the right iliac fossa in a study of 1,204 patients admitted to hospital with right lower quadrant pain little extra information was gained. The presence of right sided pain on rectal examination was more common in those with appendicitis (Odds Ratio [OR] 1.3) but this gave little diagnostic information[27]. These findings were confirmed in a further study of 477 patients with acute appendicitis and a systematic review and meta-analysis which concluded that the opinion that rectal examination is indispensible in the diagnosis of appendicitis cannot be supported[27,28].

Laboratory Investigations

Special investigations are not required to make the diagnosis of appendicitis because the diagnosis is predominantly clinical. Use of simple bedside tests and laboratory markers of inflammation can provide additional evidence to support the

diagnosis of acute appendicitis and exclude other important differential diagnosis. The majority of patients presenting with abdominal pain will have blood drawn for a complete blood count with urea and electrolyte analysis. Urine analysis and microscopy can exclude urinary tract infection, pyelonephritis, or nephrolithiasis but may be deranged in around 48% of patients undergoing appendectomy[29,30].

The most commonly used serological markers of inflammation in the diagnosis of acute appendicitis are the leukocyte count and C-reactive protein (CRP), neither is diagnostic of acute appendicitis. Studies have attempted to define potential threshold values which are predictive of a diagnosis and disease severity[22,31]. White blood cell count is raised, with neutrophils more than 70% in most of the patients. A normal leukocyte count is found in 10% of patients. A high white blood cell count (>20000/ml) suggests complicated appendicitis (gangrene or perforation). In the presence of normal inflammatory markers CRP, WBC and neutrophil count, the diagnosis of acute appendicitis is unlikely[26,32].

Given the differential diagnosis of acute appendicitis other blood tests including amylase, lipase, liver function tests, and clotting studies may be required to confirm or exclude other diagnoses. Given the limitations of the current inflammatory markers there has been considerable research interest in identifying other potential biomarkers for the diagnosis of acute appendicitis and for predicting perforation. Hyper-bilirubinemia has been shown to correlate with a diagnosis of perforated appendicitis[33] but a stronger correlation has been recently reported for CRP[34].

Interleukin-6 serum levels have not been shown to aid the diagnosis of appendicitis or reduce negative laparotomy rates[35]. The use of plasma D-lactate levels

in the diagnosis of appendicitis is unclear with some studies suggesting it may[36] or may not be a useful adjunct[37].

A recent study of 51 patients with appendicitis suggested plasma concentration of lactoferrin and calprotectin are elevated in those with appendicitis but their role in diagnosis is unclear[38].

Imaging studies

Radiography:

On plain films in 10-15% of patients of acute appendicitis a calcified appendicolith is visible. Plain abdominal radiographs may be useful for detection of ureteric calculi, small bowel obstruction, perforated ulcer. Barium study shows inability of the appendix to fill but lacks sensitivity and specificity[39].

Ultrasound:

Sonography has been suggested as a fairly accurate way to establish the diagnosis of appendicitis. Sonographic findings consistent with acute appendicitis include an appendix of 7mm or more in anteroposterior diameter, a thick-walled and a non-compressible, aperistaltic tubular structure seen in cross section, referred to as a target sign, or the presence of an appendicolith. In advanced cases, periappendiceal fluid or mass may be found[40].

Advantages of sonography are that it is a noninvasive modality, avoids exposure to ionizing radiation and is safe in pregnancy. Disadvantages being, its operator dependent and there is sometimes difficulty in interpretation of images by others. Sonography has a Sensitivity of 55 to 96% and specificity of 85% to 98%[40,41].

Computerized tomography:

It is commonly used in the evaluation of adult patients with suspected acute appendicitis. The use of 5-mm sections, have resulted in increased accuracy of CT scanning, which has a sensitivity of approximately 90% and a specificity of 80% to 90% for the diagnosis of acute appendicitis in patients with abdominal pain[42].

Classic findings include a distended appendix more than 7mm in diameter and circumferential wall thickening and enhancement, which may give the appearance of a halo or target.

As inflammation progresses, periappendiceal fat stranding, edema, peritoneal fluid, periappendiceal abscess may be seen. CT can detect appendicolith in approximately 50% of patients with appendicitis. It reduced negative appendectomy rate[43,44].

Scoring Systems

The diagnosis of acute appendicitis can be difficult and any delay in definitive treatment with surgery can lead to an increase in mortality and morbidity as the disease progresses to appendiceal perforation. This increase in morbidity and mortality has been used to justify the high rates of negative appendectomy which range from 14 to 75%[45], thus, favoring the use of clinical scoring systems in the diagnosis of appendicitis. These systems have been based on symptoms, signs and laboratory findings. In some instances they have been part of a computer-aided diagnostic algorithm[22].

The most widely cited score in the diagnosis of acute appendicitis is the Alvarado score[45]. In children the pediatric appendicitis score or Samuel score is most

widely used[46]. The scores have now been validated in a broad variety of populations, however, they have not made it into routine clinical practice in all settings[22].

A number of studies have also used computer aided diagnosis in patients with acute abdominal pain in an attempt to improve the management of patients presenting with acute abdominal pain. These systems have reported a diagnostic accuracy of 97.2% in acute appendicitis, improvement in time to surgery, with a reduction in the number of perforations over a 2 year period. They have, however, not been introduced into routine clinical practice. In an aid to further improve diagnosis artificial neural networks have been suggested as adjuncts to diagnosis but this remains an area of research with only a small number of patients having had diagnoses made in this way[47,48].

Differential diagnosis of acute appendicitis[49]

Surgical

- Perforated peptic ulcer
- Meckel's diverticulitis
- Mesenteric adenitis
- Intestinal obstruction
- Intussusception
- Acute cholecystitis
- Colonic/appendicular diverticulitis
- Rectus sheath haematoma
- Pancreatitis

Urological

- Right ureteric colic
- Right pyelonephritis
- Urinary tract infection

Gynaecological

- Ectopic pregnancy
- Ruptured ovarian follicle
- Torsion of ovarian cyst
- Salpingitis/pelvic inflammatory disease

HISTORY OF MANAGEMENT OF APPENDICITIS

It was in December 1735 when surgical removal of appendix was known. Claudius Amyand Huguenot was a refugee and founder of St.George's Hospital in London, he operated on an 11-year-old boy with long standing scrotal hernia and a faecal fistula. Through a scrotal incision, the hernia was opened, revealing omentum surrounding an appendix that was perforated by a pin, resulting in faecal fistula. The appendix and omentum were amputated, and the fistula opened with recovery[50] .

In 1848. Henry Hancock, president of the Medical society of London, presented a paper to that Society describing the treatment of a 30-years –old recently delivered women with acute peritonitis of several days duration. A right lower quadrant incision was made and foul intraperitoneal fluid was drained. Two weeks after the drainage procedure, a faecolith was removed from the wound and the patient recovered[50].

Willard Parker was an American surgeon who published a paper in 1867 recollecting his experiences, beginning in 1843, with drainage of appendicular abscesses. He reported a total of four case and advocated surgical drainage after the fifth day of illness[50]. This surgical approach gained acceptance and was later endorsed with reducing the rate appendicitis.

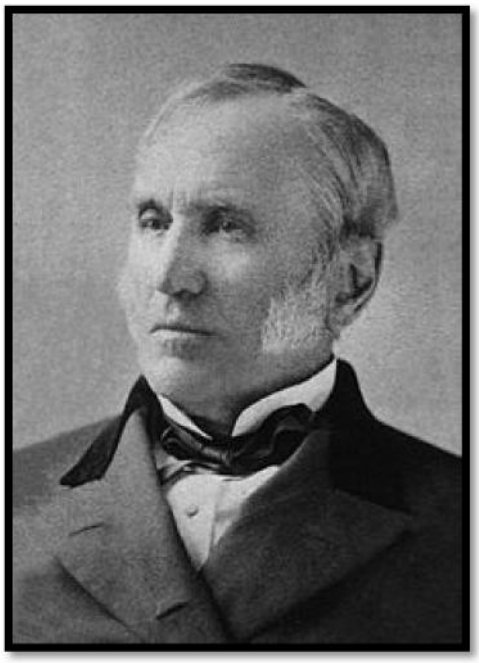


Fig 5: Willard Parker[50]

In 1880, Lawson Tait, perhaps the leading British abdominal surgeon, operated on a 17-years-old girl, removing a gangrenous appendix and the patient recovered[50]. This operation was not reported until 1890, at which time Tait had abandoned appendectomy. It is of interest that Tait steadfastly opposed Listerism.

On May 10, 1883, Abraham Groves of Fergus, Ontario saw a 12-year-old with pain and tenderness in the right lower quadrant of abdomen, he advised an operation and removed an inflamed appendix. The boy recovered[50].

In 1884 Mikulicz performed an appendectomy, but the patient did not survive[50]. In 1885, Kronlein of Zurich, following the suggestion of Mikulicz, successfully performed an appendectomy[50]. Also in 1885, Charter-Symonds of London performed an operation that was planned by a physician named Mahomed. An extra peritoneal approach to the appendix was carried out with removal of a faecolith[50].

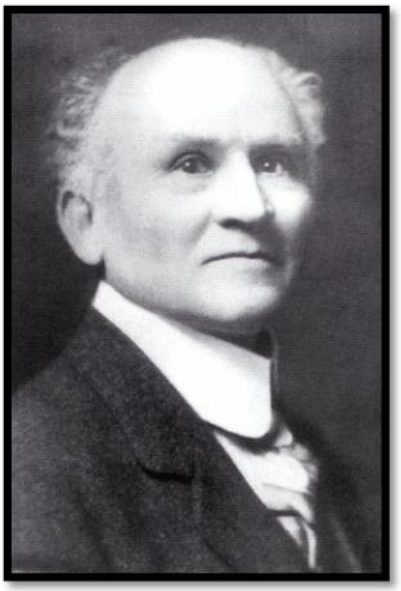


Fig 6: Abraham Groves of Fergus, Ontario[50]

It is often stated (incorrectly) that R. J. Hall in 1886 performed the first appendectomy in a case of acute appendicitis. Hall, a surgeon at the Roosevelt Hospital in York, operated on a 17-year-old male patient with an irreducible inguinal hernia. The hernia was found to contain a perforated appendix that was removed successfully and a pelvic abscess was drained.

Henry sands, who had been an assistant to Willard Parker, reported operating on a patient with appendicitis, removing two faecoliths, and closing the perforation in the appendix with sutures. Although the patient recovered, sands died not long after reporting this operation. McBurney, an assistant to Sands, commented that Sands

thoughts about appendicitis changed in the interval between the operation just described and his death[50].

Fig 7: Charles Mc Burney[50]

Thomas G. Morton of Philadelphia, in 1887, reported a successful appendectomy with drainage of an abscess in a 27-years-old patient.[50]

The operative techniques used for appendectomy have never become completely standardized. Midline vertical incisions were used in most early cases, but exposure was not adequate. The incision described by William Henry Battle of St.Thomas's Hospital in London in 1897 was a vertical incision through the lateral edge of the right rectus sheath. (Battle's Para rectal incision)[50]. Denervation of the rectus muscle was common.

The lateral muscle-splitting or "gridiron" incision is generally called the **McBurney** incision after Dr Charles McBurney of new York[50].

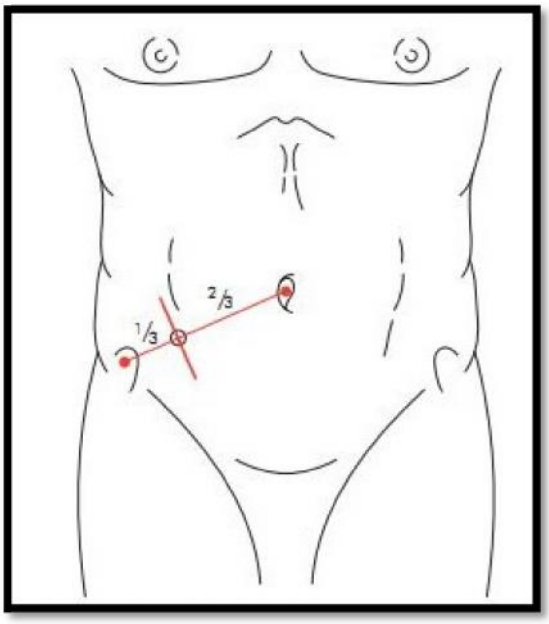


Fig 8: Gridiron incision for appendicitis, at right angles to a line joining the anterior superior iliac spine and umbilicus, centred on McBurney's point (courtesy of Professor M Earley, FRSCI,Dublin, Ireland).

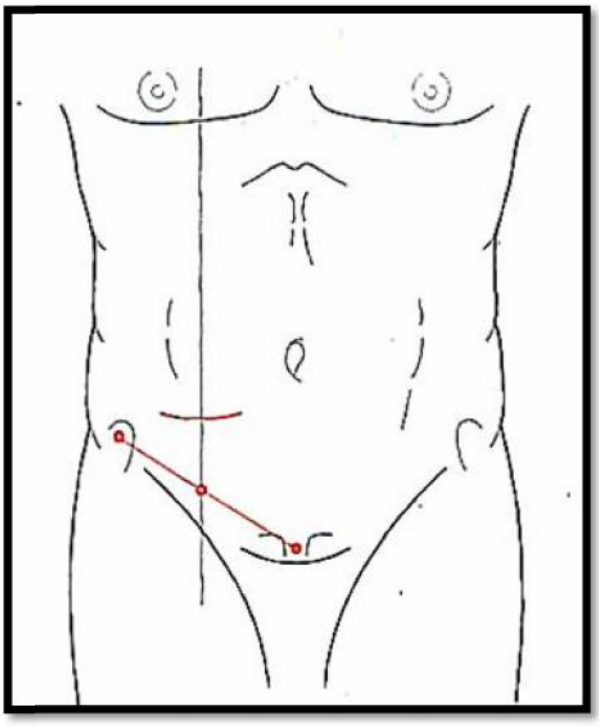


Fig 9: Transverse or skin crease (Lanz) incision for appendicitis, 2 cm below the umbilicus. Centred on the midclavicular-midinguinal line (courtesy of Professor M Earley, FRSCI, Dublin, Ireland).

Lanz incision is also known as modified McBurney's incision, Rocky-Davis or Bikini incision. It is a modification of Gridiron incision to provide a better cosmetic result. In this, instead of making skin incision at 90° to the imaginary line between the anterior superior iliac spine and umbilicus, incision is made more transverse parallel to the Langer's lines.

It has the added advantage of running parallel to the major cutaneous nerves that traverse the right iliac fossa and therefore less likely to result in transection. In the absence of a palpable appendicular mass, the Lanz incision is centred over the McBurney's point. If mass is palpated it should be moved to lay over the mass.

In 1905, A. E. Rockey of Portland, Oregon, again advocated transverse skin incisions for lower abdominal operations[50]. Rockey described vertical division of the muscle layers and did not mention muscle-splitting.

In 1906, Gwilym G. Davis of Philadelphia also advocated making transverse skin incisions, but divided the lateral portion of the rectus sheath and extended laterally by cutting the external oblique and splitting the internal oblique and transversalis in the direction of their fibers[51].

Medial extension of the gridiron incision by dividing the lateral portion of the rectus sheath was described by Harrington, Weir, and Fowler, but is most often called the Fowler-Weir extension[50].

Dawbarn suggested the use of a purse string suture, placed about the base of the appendix in the caecum, with inversion, of the unligated stump of the appendix into the caecum[50].

OPEN APPENDECTOMY

From the past 120 years, the approach to appendectomy has not changed and the person who described the technique for open appendectomy (OA) was McBurney[52,53].

At the midpoint between the right anterior-superior iliac spine and the umbilicus, just lateral of the right rectus muscle, an incision of around 5cm is taken, according to the conventional approach. The muscle layers and the fascia are dissected by using blunt dissection and electrocautery. After this, the peritoneum is opened. The caecum is identified and appendix is traced along its tenia. Appendix is held using Babcock's forceps and brought out of the peritoneal cavity followed by ligation of mesoappendix. A stump is left after dividing the base of the appendix[53].

There is still debate about the continued practice of OA. In complicated appendicitis (gangrenous and perforated appendices), OA is considered the gold standard due to lesser complications in the postoperative period like abscess or infection. If laparoscopic dissection is not possible or difficult (inflammation or adhesions], OA is used as a backup plan. Conversion from LA to OA is found to be 8.6%, but this number too is steadily decreasing as surgeons gain more experience with LA[53].

LAPAROSCOPIC APPENDECTOMY

In l902, George kelling, of Dresden, Germany, performed the first laparoscopic procedure in dogs and in 1910 Hans Christian Jacobaeus, of Sweden, reported the first laparoscopic operation in humans[54].

Kurt Semm, a German gynaecologist, was the first to radically change McBuruey's procedure when he performed the first laparoscopic appendectomy on May 30, l980[55,56]. Rather than traumatizing the abdominal Wall for exposure, Semm's technique used a laparoscope to visualize the appendix. Laparoscopic needle and suture (Endosutures) were used to secure the mesoappendix prior to division. To ligate the base of the skeletonized appendix, pre-tied Roeder's knot was used. The appendix was divided between the fixed loops. The technique was efficient, effective, and of course, minimally invasive.

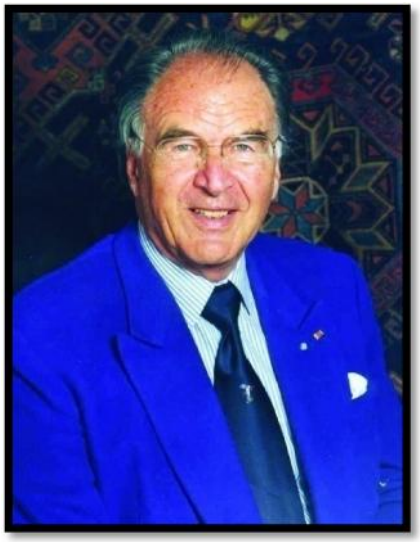


Fig 10: Dr. Kurt Semm[56]

Larson et al[57] sophisticatedly iterated several reasons why a laparoscopic approach seems preferable to open appendectomy: superior visualization. identification of lesions other than the appendix, reduced tissue trauma, the potential for more rapid return to normal activity, good exposure in obese patients and decreased wound surface area to serve as a focus for infection. Of particular importance is the capability of establishing a diagnosis in female patients of childbearing years, in whom the diagnosis may be less certain[58].

TECHNIQUE OF LAPAROSCOPIC APPENDECTOMY

There are numerous revisions and adaptations of Laparoscopic Appendectomy since Kurt Semm's initial description[59].

Instruments and energy sources have been urbanized and built-up into a more sophisticated device. Furthermore, some have tailored the procedure to using fewer number of ports, smaller size ports, or with NOTES.[60,61] What follows is one common approach to laparoscopic appendectomy.

Properative antibiotic, usually a broad spectrum cephalosporin, is given intravenously. After induction of general anaesthesia, with patient in supine position on the operating table, abdomen is painted with povidone- iodine, and the umbilicus is carefully cleansed. The operator stands to the patient's left and faces a Video monitor placed at the patient's right foot (Fig:11). A moderate Trendelenburg tilt of the operating table assists delivery of loops of small bowel from the pelvis. Pneumoperitoneum is then established, either through the "closed" technique (use of the Veress needle) or the "open" technique (Hasson blunt port insertion).

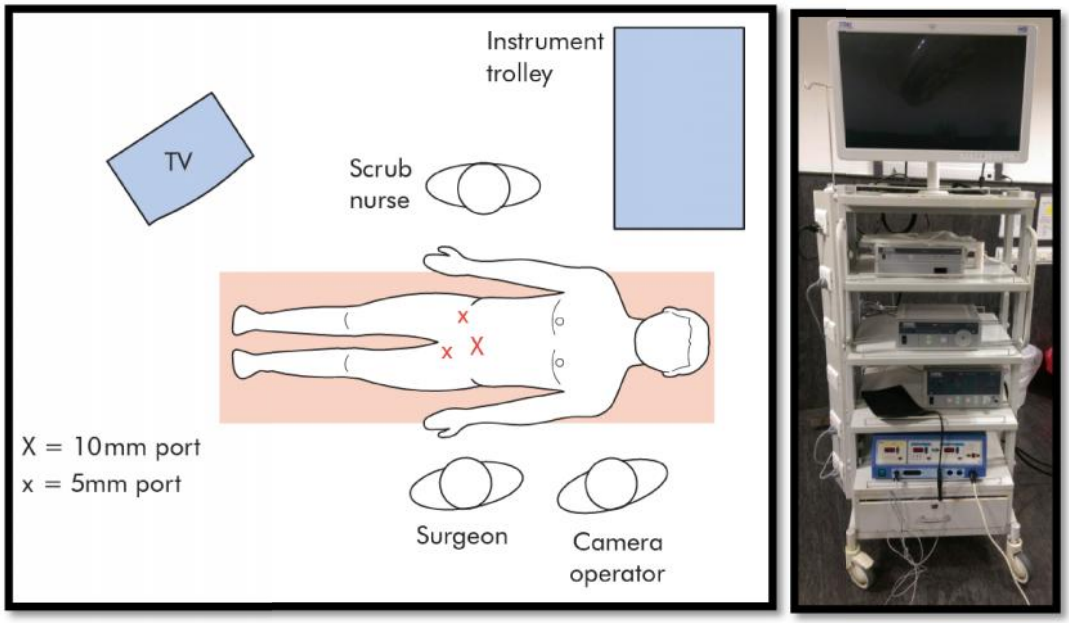


Fig 11: Operative room setup with laparoscopic tools

In the "closed" technique, a Veress needle is passed transumbilically or through the left upper quadrant. A 10-mm to l2-mm trocar and cannula is then introduced through the umbilicus. Alternately, an "open" laparoscopy technique may also be used to initiate laparoscopic access. A 1-cm incision is made in the skin at umbilicus. All layers of the abdomen are dissected till the peritoneum, which is opened under direct vision. A Hasson cannula is introduced into abdominal cavity and secured to the underlying fascia or abdominal wall[62].

The appendix is traced in the conventional manner by identification of the caecal taeniae and is held using a laparoscopic tissue holding forceps. The mesoappendix is displayed (Fig :12) and using dissecting forceps a window is created in the mesoappendix, the appendicular vessels are coagulated or ligated using a clip applicator. The appendix is then skeletonized, ligated at its base using Roeders's knot (Fig :13), divided (Fig :14) and removed through one of the working ports[63] (Fig :15). In case of spillage, the operative site must be irrigated with saline and appendicoliths if present are removed to prevent postoperative intra-abdominal abscess formation. The appendix is placed into a specimen retrieval bag and removed through the umbilical port. Fascia at the 10mm trocar site is closed, and all wounds are closed primarily.

Fig 12:Mesoappendix displayed **Fig 13: Ligation at the base of the appendix**

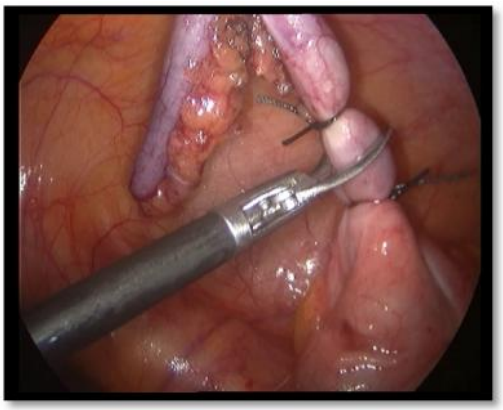


Fig 14: Division of base **Fig 15: Appendectomy complete**

POST OPERATIVE COMPLICATIONS[1]

Postoperative complications following appendectomy are relatively uncommon and reflect the degree of peritonitis that was present at the time of operation that may predispose to complications.

OPEN APPENDECTOMY COMPLICATIONS

Wound infection

It is the most common postoperative complication, occurring in 5-10 per cent of all patients. This usually presents with pain and erythema of the wound on the 4th or 5th postoperative day. Treatment is by wound drainage and antibiotics when

required. The organisms responsible are usually a mixture of Gram-negative bacilli and anaerobic bacteria, predominantly Bacteroides species and anaerobic streptococci.

Intra-abdominal abscess

Approximately 8 per cent of patients following appendectomy will develop a postoperative intra-abdominal abscess. Spiking fever, malaise and anorexia developing 5-7 days after operation is suggestive of an intraperitoneal collection. Interloop, paracolic, pelvic and sub phrenic sites should be examined. Abdominal ultrasonography and CT scan help in the diagnosis of intra-abdominal abscess and allow percutaneous drainage. Laparotomy is indicated in patients suspected of having intra-abdominal sepsis with continuing ileus.

Ileus

A period of adynamic ileus is to be expected after open appendectomy, and this may last a number of days following removal of a gangrenous appendix. Ileus persisting for more than 4 or 5 days, particularly in the presence of a fever, is indicative of continuing intra-abdominal sepsis and should provoke further investigation.

Respiratory

In the absence of concurrent pulmonary disease, respiratory complications are rare following appendectomy. Adequate postoperative analgesia and physiotherapy, when appropriate, reduce the incidence.

Portal pyaemia (pylephlebitis)

Portal pyaemia is a serious complication of gangrenous appendicitis associated with high fever, rigors and jaundice. It is caused by septicaemia in the portal venous system and leads to the development of intrahepatic abscesses (often multiple).

Faecal fistula

Leakage from the appendicular stump is a rare complication, but may occur if the encircling stitch applied at caecum has been put in too deeply or if the caecal wall is oedematous or inflammed.

In Crohn's disease, following appendectomy a fistula may occur. Conservative management with low-residue enteral nutrition will usually result in closure of faecal fistula.

LAPAROSCOPIC APPENDECTOMY COMPLICATIONS[63]

Bleeding

During laparoscopic procedures, bleeding is over estimated because of the magnification of the camera. but most conversions to open procedure occur because of this complication. Aggressive dissection of the mesoappendix may lead to bleeding. Careful dissection with control of the mesoappendix can prevent this complication, pressure of the site of bleeding with an instrument or gauze and an additional trocar facilitate identification and control of the site of bleeding. Control can be achieved by coagulation, clips, or by an endoloop.

Fecolith spillage

This is a rare, but wearisome complication. During dissection of a distended, gangrenous appendix, a fecolith may drop into the peritoneal cavity causing an intrabdominal abscess. Therefore fecoliths need to be dealt carefully and cautiously to avoid them being lost between the loops of the intestine and the pelvis.

Incomplete appendectomy

Stump appendicitis is delayed obstruction and inflammation of residual tissue left after an incomplete appendectomy. This is a serious but very rare complication.

However, incomplete appendectomy may lead to recurrent appendicitis.Poor identification of the junction between the appendix and the caecum appears to play an important role

Stump leak

A stump leak is a very rare complication. It may be related to excessive coagulation of the stump, causing tissue necrosis, or inadequately placed endoloop. It is manifested as fistula.

RECENT ADVANCES

ROBOTIC LAPAROSOPIC SURGERY

Minimally invasive surgery has improved with the help of specialized tools for over a decade now. In recent years, electronic tools have been developed to assist surgeons. Some of the features include:

- Stabilization – Electromechanical damping of vibrations and decreasing tremors.
- Visual magnification - use of a large viewing screen with HD quality improves visibility
- Simulators - use of specialized virtual reality training tools to improve surgeon's skill in surgery[64].
- In robotic surgery, ergonomically comfortable work station, master-slave programme, 3-D imaging, elimination of tremors has made a revolution[11].
- Development of a master-slave surgical platform returned the wrist to laparoscopic surgery which was a major revolution. Robotic surgery has been advertized as a solution to developing countries, where a single central hospital can control several remote machines at distant locations.

- With the intention of providing medical care while keeping trained doctors safe from battle, robotic surgery has had strong military interest as well[64].

Fig 13: Laparoscopic Robotic surgery machine[11]

SINGLE INCISION LAPAROSCOPIC SURGERY

- **Single-incision laparoscopic surgery (SILS)** is a technique recently urbanized in laparoscopic surgery. It is a minimally invasive procedure in which the surgeon operates almost through a incision, the most common being the umbilicus. On contrast to the conventional multi-port laparoscopic approach, Single incision laparoscopic surgery leaves behind only a single scar[65,66,67,68].
- Single incision appendectomy was first reported in 1994 by Inoue, where the appendix was held and pulled through incision and appendectomy was performed extracorporeallly[65].
- SILS is performed through a single incision in the umbilicus decreasing the scarring and post-operative pain at entry point of trocars used in conventional

multi-port laparoscopic surgery[69]. Specialized equipment for SILS surgery fall into two wide categories - access ports and hand instruments.

- Although knowledge of SILS is high amongst surgeons, the use of specialised instruments through such limited access requires considerable skill and training[70]. The SILS technique has been used to perform various procedures such as appendectomy, cholecystectomy, colectomy, repair of hernia, gastrectomy, bariatric surgery and nephrectomy [71-79].
- When compared with conventional multi-port laparoscopic surgery, benefits of SILS include reduced postoperative pain, smaller amount of blood loss, faster recovery time, and superior cosmetic results. Despite these advantages of SILS over the traditional multi-port laparoscopic surgery, there may also be potential disadvantages which include increased operative time, injury to organs, bleeding, post operative wound infections, incisional hernia, intestinal adhesions and scarring[66-68].

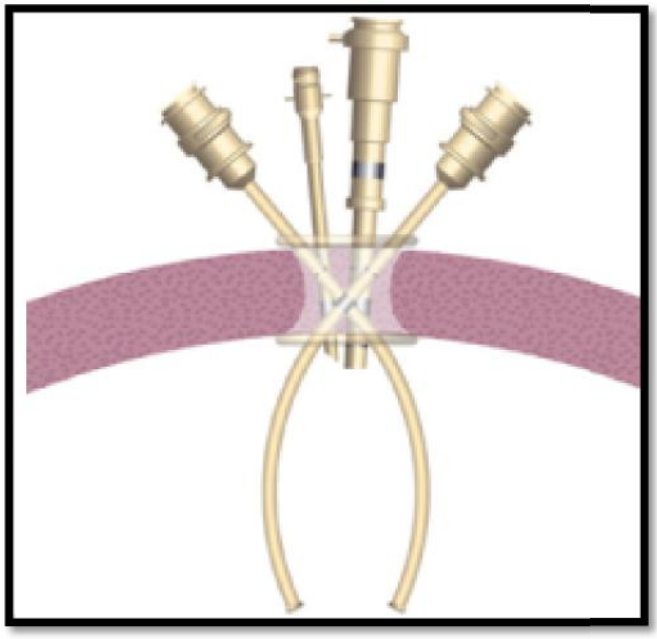


Fig 14: Technique of SILS using curved instruments[11]

NATURAL ORIFICE TRANS-LUMINAL ENDOSCOPIC SURGERY

- **Natural Orifice Trans-luminal Endoscopic Surgery (NOTES)[80]** is a surgical technique where "scar less" abdominal operations can be performed with an endoscope passed through a natural orifice (urethra, mouth, anus) then through an internal incision in the stomach, vagina, bladder[81] or colon, thus avoiding any external incisions or scars[82]. Researchers at Johns Hopkins University first performed transgastric approach in 2001, but it was in 2004 that this work was published[82].
- Rao et al[83] in 2004 performed the scar less appendectomy procedure transgastrically and addressed key issues and benefits of the procedure. NOTES appendectomy was done in 113 human patients, 87 were performed transvaginally and 26 transgastrically. Majority of cases were hybrid procedures i.e. NOTES with laparoscopic assistance, only 14 cases were pure NOTES appendectomy (11 transgastric and 3 transvaginal) and this study concluded that conversion rates (to hybrid procedures) are high[84].
- A prospective study was performed comparing transvaginal appendectomy to CLA which showed significantly less post-operative demand of analgesia and faster return to daily activity with no difference in operative time and length of hospital stay in patients who underwent transvaginal appendectomy. The article concludes transvaginal appendectomy to be safe and feasible, but suggested larger RCT's to be conducted[85].
- Promising advantages of NOTES include decreased anaesthesia requirements, faster recovery, shorter hospital stays, avoidance of complications of transabdominal wound infections (e.g.hernias), better postoperative

diaphragmatic and pulmonary function, with the most potential advantage of "scarless" abdominal surgery[83-85].

- The safety and advantages of this minimally invasive technique over laparoscopic surgery is criticized, in women although transvaginal approach of appendectomy appears promising, three-quarters of patients are neutral or unhappy with NOTES[86]. On the other hand, research continues in addressing the challenge faced in transvaginal approach. Proposed solutions include the use of permanent magnets[87,88,89].
- Palanivelu et al[90] conducted a prospective study “Transumbilical endoscopic Appendectomy in Humans : On the road to NOTES” and proposed the need to address several key issues prior to incorporation of NOTES into routine surgical practice.

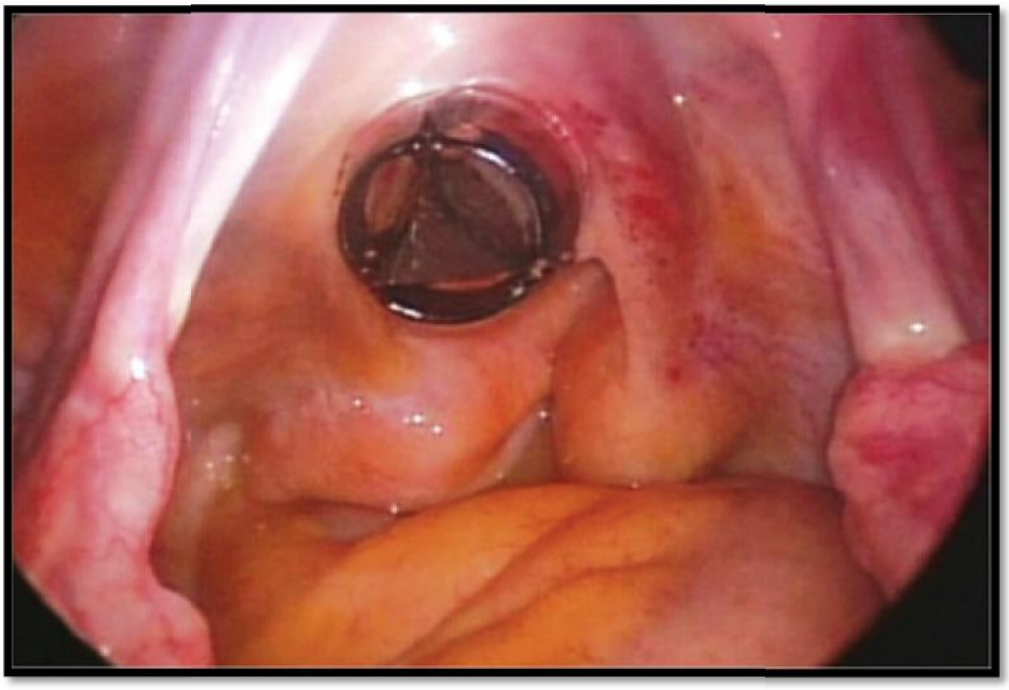


Fig 15: Transvaginal Endoscopic Appendectomy[82]

DOUBLE INCISION LAPAROSCOPIC APPENDECTOMY

- Dr.Vipul D Yagnik conducted a retrospective study comparing two port appendectomy with open appendectomy and three port appendectomy concluded that two port appendectomy technique significantly reduces operative time with less post-operative pain as well as length of hospital stay and reduces surgical site infection[6].
- Recently, Turgut Donmez et al[91] performed two-port laparoscopic appendectomy assisted with a needle grasper and compared it with conventional laparoscopic appendectomy. This procedure showed better cosmetic results and significantly lower pain score 12 hours after surgery.
- Similar study on two port laparoscopic appendectomy as evolution to Laparoendoscopic single site surgery (LESS) concluded that the use of two port laparoscopic appendectomy can act as a LESS immediate step procedure, without loss of instrumental triangulation and maintenance of appropriate counter traction and this technique can be used and an alternate to the three port laparoscopic procedure[92].
- Another novel technique was introduction of hypodermic needle in right iliac fossa to retract the appendix which was safe and feasible, at the same time being cosmetically acceptable[93].
- Double incision laparoscopic appendectomy has all the advantages over conventional appendectomy as umbilical and suprapubic port scars are hidden by natural camouflages, right iliac fossa being the only visible sign of surgery.
- There have been many other several studies comparing the newer techniques of performing laparoscopic appendectomy – needlescopic technique, single

port laparoscopic appendectomy, robotic appendectomy, Natural orifice Trans-luminal Endoscopic Surgery (NOTES) although meta-reviews of these have turned out to be inconclusive, wanting the need for further evidence.

- As a bridge between conventional laparoscopic surgery and NOTES, the recent spotlight is on the development of single incision laparoscopic surgery (SILS) and double incision laparoscopic surgery (DILS) to further lessen the invasiveness of laparoscopic surgery by reducing the number of incisions.

METHODOLOGY

The present study was conducted in the Department of General Surgery, KLES Dr. Prabhakar Kore Hospital and Medical Research Centre, Belagavi from January 2015 to December 2015.

Study design

The study design was a randomized controlled trial.

Study period and duration

The present study was conducted for one year from January 2015 to December 2015.

Place

The present study was carried out in the Department of General Surgery, KLES Dr. Prabhakar Kore Hospital and Medical Research Centre, Belagavi a tertiary care teaching hospital attached to KLE University's Jawaharlal Nehru Medical College, Belagavi.

Source of Data

Patients diagnosed with appendicitis (Acute, chronic or recurrent) and undergoing laparoscopic appendectomy were included in the study.

Sample size

A total of 60 patients divided into two groups of 29 in conventional three port laparoscopic appendectomy and 31 in double incision three port laparoscopic appendectomy were studied.

Sampling procedure

Sample size is calculated by using the formula

$$N=2(Z\alpha+Z\beta)^2((S_1)^2+(S_2)^2) / (X_1-X_2)^2$$

$Z\alpha=1.96$ $S_1=19$ $X_1=59MIN$ $\alpha=0.05$

$Z\beta=0.84$ $S_2=11$ $X_2=40MIN$ $\beta=0.2$

N=20.9

As the sample size obtained by the formula is low 30 patients are taken in each group

Randomization

Patients were divided into two groups as group A and B by Sequential Numbered Opaque Envelope Method

Selection criteria

Inclusion

- Patients diagnosed with appendicitis and willing for laparoscopic appendectomy.
- Clinically diagnosed as appendicitis
- Patients aged between 15 to 60 years.
- Clinically and radiologically diagnosed as uncomplicated appendicitis

Exclusion

Patients with

- Bleeding disorders
- Immunocompromised state

- Pregnancy
- Complicated appendicitis (i.e) perforated appendicitis with peritonitis
- Pediatric age group (below 15years)
- Previous major abdominal surgery like exploratory laparotomy

Ethical clearance

Prior to the commencement, the study was approved from the Ethical and Research Committee, Jawaharlal Nehru Medical College, Belagavi.

Informed Consent

The patients fulfilling selection criteria were informed in detail about the nature of the study and a written informed consent was obtained before enrollment (Annexure I).

Method of collection of data

Patients were interviewed and demographic data such as age, sex and the presenting symptoms were noted. These patients were subjected to clinical examination and evaluated for vitals and clinical signs. These findings were recorded on a predesigned proforma (Annexure II).

Investigations

The following investigations were done

- Routine blood investigations including:
    - Complete blood count.
    - Urine examination (routine and microscopy)

- Bllod Urea
- Serum Creatinine
- Liver function test
- Ultrasound abdomen

Diagnosis of appendicitis

Diagnosis of appendicitis was based on disease history (Right Iliac Fossa pain, vomiting, nausea, anorexia, fever) and clinical signs (McBurney's point tenderness, Rebound Tenderness), and laboratory tests (elevated leukocyte count). The preoperative diagnosis of appendicitis was confirmed by ultrasound abdomen and pelvis revealing either probe tenderness in the right Iliac fossa or an aperistaltic, tubular appendix.

PROCEDURE

Patient positioning

The patient was placed in a supine position, combined with the Trendelenburg position and left lateral position (10–15º, inclined towards the surgeon). The surgeon and an assistant stood on the left side, and the monitor was placed on the right side of the patient.

Anaesthesia

All the surgeries were performed under general anesthesia.

Surgical technique

All the laparoscopic appendectomies were performed by the same surgeon.

TECHNIQUE OF CONVENTIONAL LAPAROSCOPIC APPENDECTOMY

The abdomen is prepared with antiseptic (povidone- iodine), and the umbilicus is carefully cleansed. Through the umbilicus, a 10 mm port was inserted after creating pneumoperitoneum by Hasson's open technique or closed technique using Veress needle and another 5 mm port was inserted in the midline lower pelvic (suprapubic) region. One 5 mm trocar was inserted in the right lower quadrant forming a triangle with the previous two ports.

The appendix is found in the conventional manner by identification of the caecal taeniae and is held using a grasper. By elevating the appendix, the mesoappendix is displayed. A dissecting forceps is used to create a window in the mesoappendix, the appendicular vessels are coagulated. The appendix, free of its mesentery is ligated at its base with Roeder's knot. Appendix is then divided between the Roeder's knots and removed through 10mm operating port at umbilicus by shifting camera to the 5mm supra-pubic port.

TECHNIQUE OF DOUBLE INCISION THREE PORT LAPAROSCOPIC APPENDECTOMY

Pneumoperitoneum is established, either through the “closed” technique (use of the Veress needle) or the “open” technique (Hasson blunt port insertion).

A 1-cm incision is made in the skin about the umbilicus A 10-mm trocar and cannula is introduced through the umbilicus. The camera is then introduced via the umbilical cannula. 5-mm trocar and cannula under direct vision introduced in the suprapubic region. Camera shifted to 5mm supra-pubic port and under vision another 5mm trocar is inserted along 10mm umbilical port by extending the umbilical incision further by 5mm. Camera shifted back to umbilicus. The appendix is found in the conventional manner by identification of the caecal taeniae and is held using a grasper. By elevating the appendix, the mesoappendix is displayed. A dissecting forceps is used to create a window in the mesoappendix, the appendicular vessels are coagulated. The appendix, free of its mesentery, ligated at its base with Roeder’s knot. Appendix is then divided between the Roeder’s knots and removed through 10mm umbilical port under vision by shifting camera to the 5mm working supra-pubic port.

Photograph 1. 10mm (left) and 5mm (right) 30 HD laparoscopes

Photograph 2. Port placement in CLA

Photograph 3. Port placement in DILA

Photograph 4. Umbilical Port site after removal of ports in DILA

Photograph 5. CLA Post operative picture (Day-3)

Photograph 6. DILA Post operative picture (Day-3)

Photograph 7. CLA Post operative picture after suture removal (Day-7)

Photograph 8. DILA Post operative picture after suture removal (Day-7)

Post operative care

Post operative management was the same for both the groups. Both groups were monitored for any complications till discharge from the hospital. The skin sutures were removed between postoperative day seven to ten. Routine follow up examinations were ordered for all patients for first two months after surgery.

Outcome variables

The following variables were evaluated intra operatively and post operatively.

- Operative time – time taken from skin incision to delivery of the appendix
- Post operative pain – 6 hours and 24 hours after surgery by visual analogue scale
- Patients Satisfaction with cosmetic outcome by visual analogue scale

Statistical analysis

The data was entered into the Microsoft Excel Spreadsheet (Annexure III). The data was analyzed using SPSS statistical software version 20.0. The categorical data was expressed as rates, ratios and percentages and comparison was done using Fishers exact test and chi-square test. Numerical data was compared by students t test. A probability ('p' value) of less than or equal to 0.05 at 95% confidence interval was considered as statistically significant.

RESULTS

This prospective study consisted of 60 patients with diagnosis of Acute Appendicitis who were admitted in the surgical ward at KLES Dr.Prabhakar Kore Hospital and MRC, Belagavi and underwent Laparoscopic Appendectomy during January 2015 to December 2015.

All cases underwent detailed preoperative assessment; their duration of surgery and postoperative pain were meticulously recorded as per protocol. The findings were tabulated and the following observations were made.

All the patients were divided into two groups.

Total no .of cases 60

Group A- Conventional Three port LA (CLA) - 29cases

Group B- Double incision three port LA (DILA) - 31cases

All the 60 patients were diagnosed to have Appendicitis by history, clinical examination and abdominal ultrasonography. All the patients after being fit for surgery were posted for Laparoscopic appendectomy under general anaesthesia and were selected randomly for CLA or DILA, which were operated by a single surgeon.

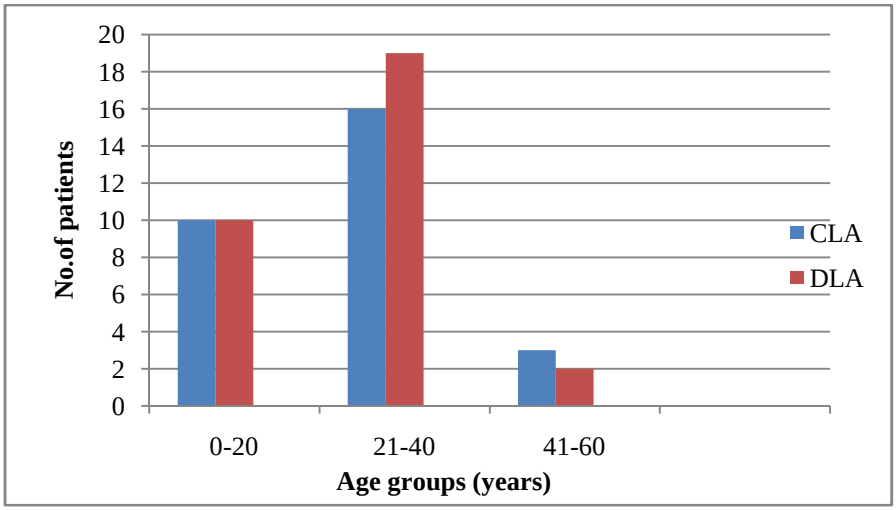
This Comparative study with 29 patients undergoing CLA procedure and 31 patients undergoing DILA procedure was undertaken to study the duration of operation, postoperative pain and cosmetic satisfaction between both the groups. Descriptive statistical analysis has been carried out in the present study.

Table 1: AGE DISTRIBUTION

Age groups (Years)	Group A	Group B	Total
0-20	10	10	20
21-40	16	19	35
41-60	3	2	5
Total	29	31	60

Age groups (Years)	Group A	Group B	P Value
Mean	28	25.9	0.480
SD	11.64	11.19	

GRAPH 1: AGE DISTRIBUTION



In Group A, 10 patients were in the age group of 0-20 years, 16 patients were in the age group of 21-40 years and 3 patients were in the age group of 41-60 years with a mean age of 28 years and a standard deviation of 11.64 years.

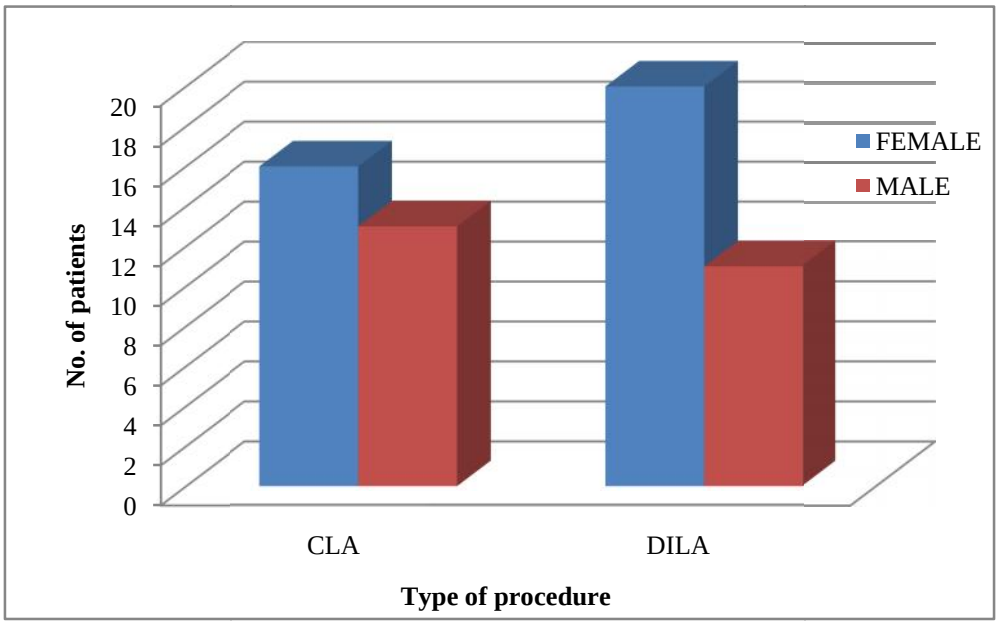
In Group B, 10 patients were in the age group of 0-20 years, 19 patients were in the age group of 21-40 years and 2 patients were in the age group of 41-60 years with a mean age of 25.9 years and a standard deviation of 11.19 years

Table: 2 SEX DISTRIBUTION

Sex	Group A	Group B	Total
Female	16 (55.2%)	20 (64.5%)	36
Male	13 (44.8%)	11 (35.5)	24
Total	29	31	60

P value: 0.460

GRAPH 2: SEX DISTRIBUTION



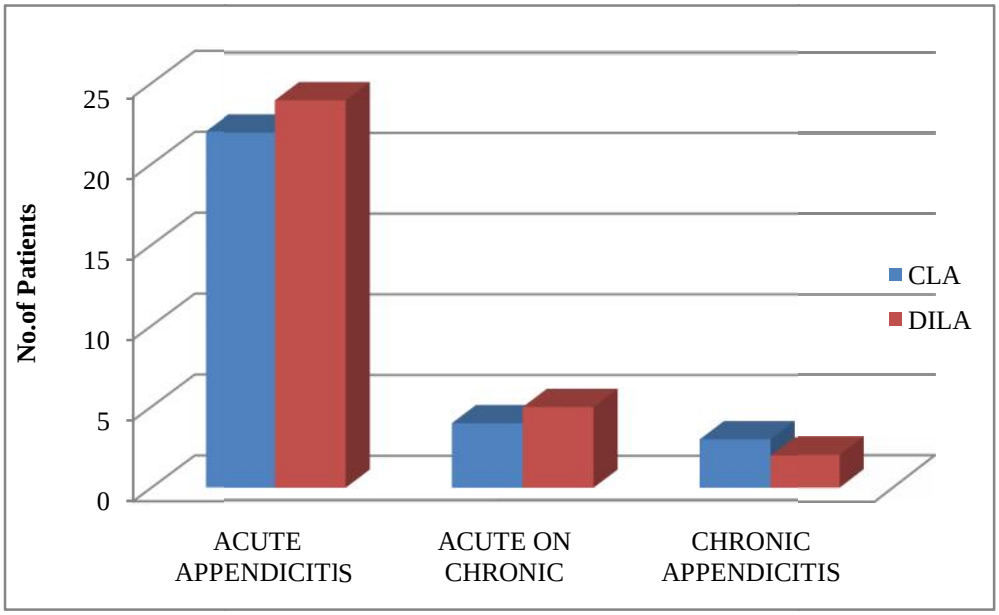
In Group A, there were 16 female and 13 males while in Group B there were 20 female and 11 males with a P value of 0.460 which is insignificant.

TABLE 3: DIAGNOSIS

Group	Acute Appendicitis	Acute on Chronic Appendicitis	Chronic Appendicitis	Total
Group A	22 (75.86%)	4 (13.79)	3 (10.3%)	**29**
Group B	24 (77.41%)	5 (16.12%)	2 (6.45%)	**31**
Total	**46 (76%)**	**9 (15%)**	**5 (8.33%)**	**60**

P value: 0.847

GRAPH 3: DIAGNOSIS

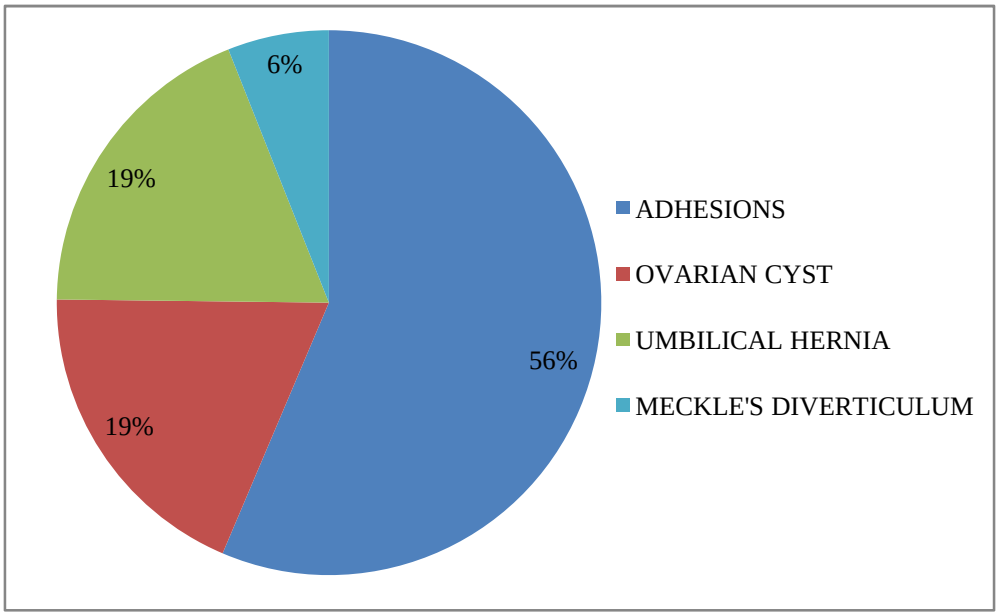


In Group A, 22 patients (75.86%) were diagnosed with acute appendicitis while in Group B there were 24 patients (77.41%) with acute appendicitis with a P value of 0.847 which is insignificant.

TABLE 4 : ADDITIONAL INTRA-OP FINDINGS

Additional Intra-op Findings	Group A	Group B	Total
Adhesions	4 (13.7%)	5 (16.1%)	**9 (15%)**
Ovarian cyst	2 (6.8%)	1 (3.22%)	**3 (5%)**
Umbilical Hernia	1 (3.44%)	2 (6.45%)	**3 (5%)**
Meckle's Diverticulum	**1 (3.44%)**	**0**	**1 (1.66%)**

GRAPH 4: ADDITIONAL INTRA-OP FINDINGS



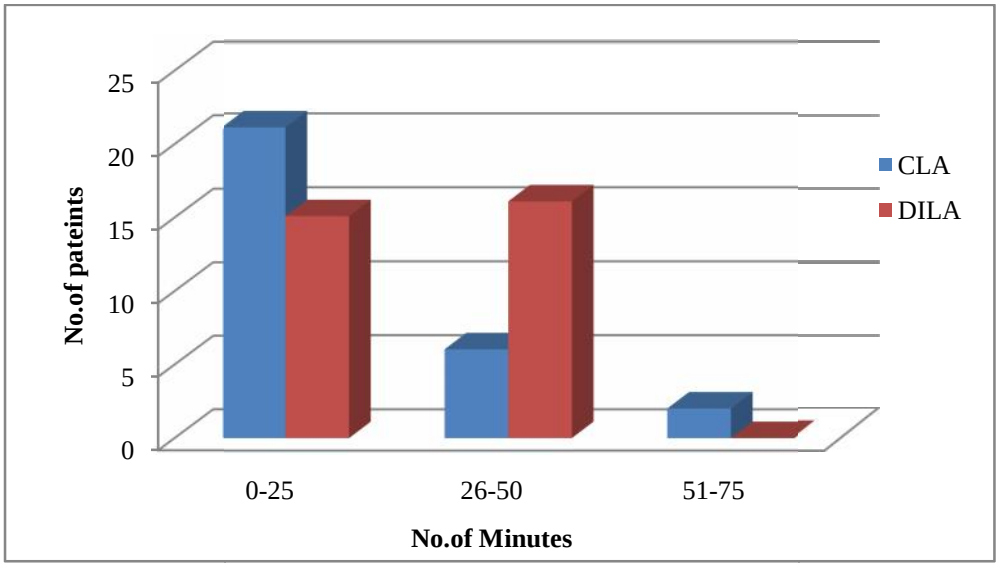
In Group A, 4 patients (13.74%) had adhesions, 2 patients (6.8%) had ovarian cysts, 1 patient (3.44%) had umbilical hernia and 1 patient (3.44%) had Meckle's Diverticulum. While in Group B, 5 patients (16.1%) had adhesions, 1 patient (3.22%) had ovarian cyst, 2 patients (6.45%) had umbilical hernia.

TABLE 5: DURATION OF SURGERY

Duration (min)	Group A	Group B	Total
0-25	21 (72.4%)	15 (48.38%)	36 (60%)
26-50	6 (20.6%)	16 (51.6%)	22 (36.6)
51-75	2 (6.8%)	0	2 (3.3%)
Total	29	31	60

Duration (min)	Group A	Group B	P Value
Mean	26.4	27.6	0.62
SD	12.12	7.86	

GRAPH 5: DURATION OF SURGERY



In our study, the mean operative time was 26.4 minutes in Group A and 27.6 minutes in Group B with a P value of 0.62 which is insignificant. Hence the overall mean operative time was almost equal in both the groups.

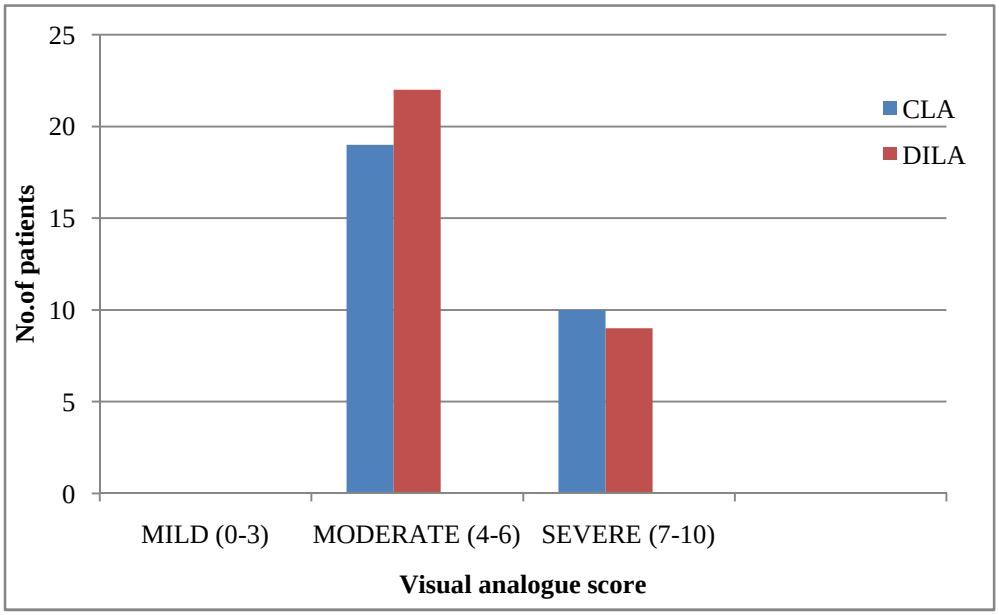
Table 6: POST OPERATIVE PAIN 6 HOURS AFTER SURGERY

Pop	Group A	Group B	Total
Mild (0-3)	0	0	0
Moderate (4-6)	19 (65.5%)	22 (70.9%)	41 (68.3%)
Severe (7-10)	10 (34.4%)	9 (29.03%)	19 (31.66%)
Total	29	31	60

Duration (min)	Group A	Group B	P Value
Mean	6.5	6.4	0.62
SD	1.4	1.2	

P value: 0.62

GRAPH 6: POST OPERATIVE PAIN 6 HOURS PAIN AFTER SURGERY



Pain score in Group A 6 hours after surgery

- 0 patients with a score of 0-3 (mild pain)
- 19 patients with a score of 4-8 (moderate) and
- 10 patients with a score of 7-10 (severe)

Pain score in Group B 6 hours after surgery

- 0 patients with a score of 0-3 (mild pain)
- 22 patients with a score of 4-6 (moderate)
- 9 patients with a score of 7-10 (severe)

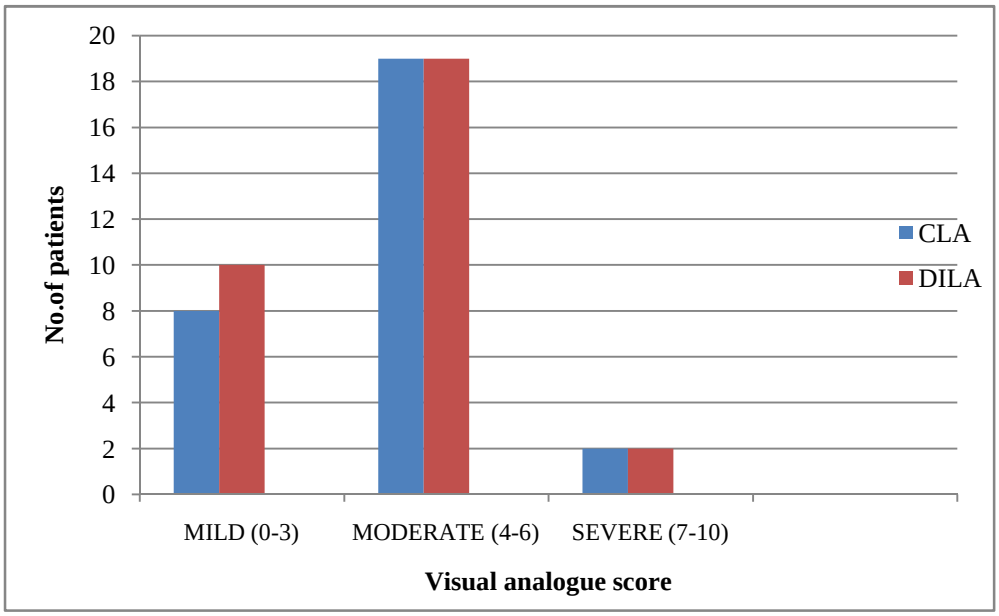
The comparative P value is 0.62

TABLE 7: POST OPERATIVE PAIN 24 HOURS AFTER SURGERY

Pop	Group A	Group B	Total
Mild (0-3)	8 (27.5%)	10 (32.2%)	18 (30%)
Moderate (4-6)	19 (65.51%)	19 (61.2%)	38 (63.3%)
Severe (7-10)	2 (6.8%)	2 (6.4%)	4 (6.66%)
Total	29	31	60

Duration (min)	Group A	Group B	P Value
MEAN	4.3	4.1	0.484
SD	1.85	1.93	

GRAPH 7: POST OPERATIVE PAIN 24 HOURS AFTER SURGERY



Pain score in Group A 24 hours after surgery

- 8 patients with a score of 0-3 (mild pain)
- 19 patients with a score of 4-8 (moderate) and
- 2 patients with a score of 7-10 (severe)

Pain score in Group B 24 hours after surgery

- 10 patients with a score of 0-3 (mild pain)
- 19 patients with a score of 4-6 (moderate)
- 2 patients with a score of 7-10 (severe)

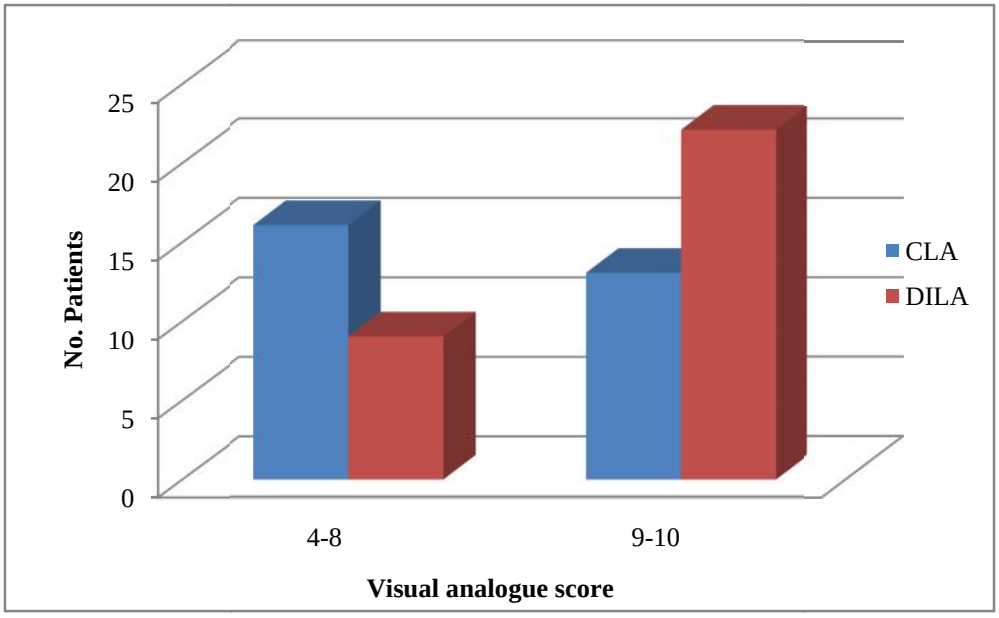
The comparative P value is 0.484

TABLE 8: COSMETIC OUTCOME

Score	Group A	Group B	Total
4-8	16(55%)	9(29%)	**25 (41.6%)**
9-10	13(45%)	22(71%)	**35 (58.3%)**
Total	**29**	**31**	**60**

P Value-0.04 (SIGNIFICANT)

GRAPH 8: COSMETIC OUTCOME



In Group A, there were 16 patients satisfied and 13 patients highly satisfied while in Group B there were 9 patients satisfied and 22 patients highly satisfied with a P value of 0.04 which is significant.

DISCUSSION

Surgical management of appendicitis has advanced from open techniques to minimally invasive techniques and now laparoscopic appendectomy is the gold standard of treatment. In a well known meta-analysis comparing laparoscopic to open appendectomy by Sauerland et al., has shown laparoscopic group stayed 1.1 fewer days in hospital, returned to work 5 days earlier and a reduction of pain by 8mm on a 100mm visual analogue scale[5].

Now in, the era of laparoscopic appendectomy, still lesser invasive techniques have come up, which are being performed transumbilically, such as two-port laparoscopic appendectomy and single port laparoscopic appendectomy.

For better cosmetic outcome (scarless abdomen) natural orifices like mouth, urethra, anus and vagina have also been explored, through which appendectomy have been done, which is known as Natural orifice transluminal endoscopic surgery (NOTES). It has a superior cosmetic outcome with certain drawbacks like requiring a multidiscipilinary team along with ethical problems related to the trans-vaginal route[94].

There are many studies done comparing SILS to CLA which have concluded that the primary advantage of Single incision laparoscopic appendectomy is cosmesis. The limitations of SILS are – it is difficult to perform, bigger umbilical incision, high risk of port site incisional hernia, longer duration of surgery, needs specialized instruments, steep learning curve[8,9,53,70,72].

As a bridge between SILS and CLA various studies have been done by reducing the number of ports and comparing SILS and CLA to port-exteriorization appendectomy, needlescopic appendectomy, extracorporeal appendectomy, laparoscope assisted appendectomy and needle loop retractor appendectomy[6,91,92,93].

We have done a similar kind of study comparing Conventional laparoscopic appendectomy to double incision laparoscopic appendectomy, although there is no reduction in the number of ports, movement of 5mm port from the right iliac fossa to the umbilicus resulted in avoidance of a large incision at umbilicus as in SILS and scars being hidden in the umbilicus.

Our study had a age limit, i.e. 15-60 years and the commonest age group was 20-40years. The mean age in group A was 28 ± 11.64 years and in group B the mean age was 25.9 ± 11.19 years (p=0.480). These findings suggest that, most of the patients who presented with appendicitis were young. Most of the earlier studies[6,16.19] in the literature have observed that appendicitis is common in the this age group.

In the present study frequency of females was slightly high in both the groups. In group A, 55.2% of the patients were females and in group B females constituted 64.5%. Though appendicitis was common among females in both the groups, the difference was statistically not significant (p=0.460). A study by Rammohan A. et al[93] where hypodermic needle was used to extracorporeally ligate the base of appendix also reported high frequency of females 55%.

A study of 248 patients comparing single-port laparoscopic appendectomy to conventional laparoscopic appendectomy showed 37.9% of patients with acute appendicitis and 32.6% with acute suppurative appendicitis[95]. As compared to this

study, in our study majority of the patients in group A (75.86%) and group B (77.41%) were diagnosed to have acute appendicitis.

Diagnostic laparoscopy was performed in those cases, where it was felt necessary. We visualized other associated intraabdominal pathologies in 16 patients. Out of 9 patients with adhesions 7 patients were females and the adhesions were present commonly at the site of tubectomy scar which was released with the help of electrocautery. In three cases puncture of ovarian cyst with aspiration of cystic fluid was done and umbilical hernia repair was carried out at the end of the procedure after removal of the umbilical ports. Wani M et al[96] conducted a study comparing single incision laparoscopic appendectomy and conventional laparoscopic appendectomy and observed additional findings in 23.3% of patients undergoing SILS and 20% of patients undergoing CLA compared to the our study where additional findings were observed in 27.5% of patients in group A and in 25.8% of patients in group B suggesting that these other intra-abdominal pathologies can be dealt with comfortably in DILA without need of extra ports.

In the present study duration of DILA procedure was slightly longer than CLA procedure, the mean operative time was 26.4 minutes in CLA procedure and 27.6 minutes for DILA procedure. The mean operation time of 27.6 min in DILA group of our study is shorter than that reported in other studies of double incision laparoscopic appendectomy. Mean operative time of 35.74 minutes was noticed during extra-corporeal ligation of appendix[6], 55.7 minutes when using a needle loop retractor to retract and manipulate the appendix at McBurney's point[93] and 57.03 minutes was taken when a needle grasper device was introduced at McBurney's point to hold the appendix[91]. Findings of the present study were also comparable to a recent study on

single incision laparoscopic surgery in which the mean operative of procedure was 57.66 minutes[96]. These findings show that DILA is comparable and equivalent to CLA in terms of duration of surgery.

When compared with conventional laparoscopic appendectomy, double incision three port laparoscopic appendectomy did not increase surgical difficulty. Lee et al[97] conducted a retrospective study and reported that when the surgeon gained experience, the operative time was decreased.

Post operative pain was assessed using visual analogue scale 6 hours and 24 hours after surgery. The mean post-operative pain in group A was 6.5 and 6.4 in group B in the first 6 hours compared to post-operative pain noticed in a study by Turgut Donmez et al[91] in which the mean post-operative pain was 4.37 in CLA group and 4.25 in DILA group. The mean post-operative 24hours after surgery in the present study was 4.3 in group A and 4.1 in group B which is less compared to mean post-operative pain in a recent study comparing post-operative pain in SILS and CLA which reported significantly higher pain 24hours in patients who underwent SILS in the first 24 hours i.e. 6.1 in SILS and 4.7 in CLA[98]. Post operative pain may be independent of the type of procedure performed, the probable reasons being, acutely inflamed appendix and surrounding tissue inflammation will cause pain in the post-operative period even after removal of the inflamed appendix and the other reason being, reduction in the amount of trauma by shifting port from right iliac fossa to the umbilicus was not immense[99]. In our present study both the groups had experienced similar pain.

In CLA, the use of 5 mm ports in RIF or LIF regions often leave clearly visible scars. We have demonstrated that DILA avoids the right iliac fossa incision

and the suprapubic trocar is placed tactically below the waist line to be a safe and feasible procedure. It was difficult to find a standardized tool which is universally accepted to assses cosmetic outcome Cosmesis is a subjective satisfaction and scar which seems to be satisfactory to one person may not be same for another person. . The cosmetic score in our study was measured using a 10-point VAS, In group A, there were 16 patients satisfied and 13 patients highly satisfied with their scars while in group B there were 9 patients satisfied and 22 patients highly satisfied with a P value of 0.04 which is significant. No DILA studies have evaluated the cosmetic results objectively till date, so there is need for similar kind of studies. However, as compared with SILS there might also be potentially reduced risk of developing port-site incisional hernia in the umbilicus.

A retrospective study done between 1998 and 2008 claimed that reduction in the number of trocars reduces the risk of trocar site adhesions. DILA technique eliminates one site of peritoneal invasion thereby reducing the chances of adhesions[100].

This modification of the 5mm port from the right iliac fossa to the umbilicus did not increase surgical difficulty, there was no difficulty in manipulation of appendix.

Overall the results of this study suggest that double incision three port laparoscopic appendectomy has acceptable operative outcomes which is equivalent to conventional laparoscopic appendectomy with superior cosmetic results and has a advantage over SILS and NOTES in being safe, easy, feasible without the need for specialized instruments and also in an economic point of view.

CONCLUSION

The present study of Conventional laparoscopic Appendectomy (CLA) versus Double incision three-port Laparoscopic Appendectomy (DILA) has proved that DILA can be performed with operative time equivalent to CLA, thus a feasible and safe procedure. The cosmetic outcome was also better in DILA compared to CLA. Even surprise additional intra-abdominal pathologies were able to deal with DILA. We believe that, over a period of time with experience and learning curve, DILA may replace CLA as a standard procedure, but further larger studies and multi-centre trials have to be done to support this.

SUMMARY

Double incision laparoscopic surgery (DILS) is a bridge between conventional laparoscopic surgery and NOTES. The present study was an effort to evaluate the efficacy of Double incision three port laparoscopic Appendectomy as an alternative and equivalent to Conventional Three-port Laparoscopic Appendectomy by comparing the operative time, post-operative pain and satisfaction with cosmetic outcome.

This one year randomized controlled trial was done in the Department of General Surgery, KLES Dr. Prabhakar Kore Hospital and Medical Research Centre, Belgaum from January 2015 to December 2015. A total of 60 patients undergoing laparoscopic appendectomy were enrolled. Based on the intervention, patients were divided into two groups, Group A – 29 patients (conventional laparoscopic appendectomy) and Group B – 31 patients (Double incision three port laparoscopic appendectomy).

In the present study 55.2% of the patients in group A were females compared to 44.8% in group B (p=0.460). The mean age in group A was 28 years and in group B it was 25.9 (p=0.480). The mean operative time was 26.4 minutes in group A and 27.6 minutes in group B (p=0.62) which is not significant. Moderate pain score (4-8) in the 6 hours after surgery was higher in group B (P=0.62). However, there were no differences for 24 hours after surgery between both the groups (p=0.484). In group A, there were 16 patients satisfied and 13 patients highly satisfied while in group B there were 9 patients satisfied and 22 patients highly satisfied (P = 0.04) which is significant.

On comparison of both the groups, mean operative time, post-operative pain 6 hours and 24 hours post-operative were not statistically significantly (p=0.62, p=0.62 and p=0.484 respectively) However, satisfaction with cosmetic outcome was significant (p=0.04) in group B.

Based on the results of this study it may be concluded that, Double incision three port laparoscopic appendectomy is equivalent to conventional laparoscopic appendectomy with superior cosmetic results and acceptable operative outcomes.

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ANNEXURE I – CONSENT FORM

Mr./Mrs./Miss……..we are requesting you to enroll yourself in study titled **"CONVENTIONAL LAPAROSCOPIC APPENDECTOMY VERSUS DOUBLE INCISION THREE PORT APPENDECTOMY: A ONE YEAR RANDOMIZED CONTROLLED TRIAL AT KLE'S DR. PRABHAKAR KORE HOSPITAL & MRC, BELAGAVI"** by Department of General surgery, J.N. Medical College, Belagavi under KLE university, Belagavi.

Respected Sir/Madam we request you to enroll yourself too participate in our study, as you are eligible for participating in the study. During the study you will be asked some questions regarding your present complaint and you are supposed to answer to the best of your knowledge.

Your participation in research is voluntary. Your decision whether or not to participate in the study will not affect your relationship with J.N. Medical College and KLE'S DR. PRABHAKAR KORE HOSPITAL & MRC, BELAGAVI. If you decide to participate you are free to withdraw at any time.

The purpose of the study is to assess the time duration of surgery, post-operative pain and cosmetic outcome in conventional laparoscopic appendectomy versus double incision three port laparoscopic appendectomies.

Purpose of the study:

There has been many studies comparing the newer techniques of performing laparoscopic appendectomy with the conventional laparoscopic appendectomy, although meta-reviews of these have turned out to be inconclusive, warranting the need for further evidence. Till now, no study has been done in our institution comparing these two techniques. Thus, local evidence-based guidelines can be formulated for the same, in the view of the mentioned confusions and the paucity of literature. There is need for local guidelines to be drafted. This study is conducted to compare the time duration of surgery, post-operative pain and cosmetic outcome in conventional laparoscopic appendectomy versus double incision three port laparoscopic appendectomies.

Procedure involved:

If you agree to enroll yourself in my study, I will ask your present, past and family history. Then you will be clinically examined in detail and routine investigations like HB, TC, DC, PLATELET COUNT, RBS, BLOOD UREA, SERUM CREATININE, BLOOD GROUPING, CHEST X RAY, ECG, will be done accordingly. You will be allotted into one of the two groups randomly using sequential numbered brown opaque envelope method. One group laparoscopic appendectomy is done by conventional technique and the other group by double incision three port technique, observed for time taken for surgery, pain post operatively and cosmetic outcome.

Risks:

There are few rare risks involved with use of either two techniques. it may include minor complications like the port site infection, subcutaneous emphysema, or bleeding from the epigastric vessels to major complications gas embolus(0.001%), the major vascular injury(0.003-1.33%) or visceral injury(0.04-4%) and are rather rare. management depends on the type of the complication . major complications is an indication for an urgent laparotomy and minor ones managed conservatively.

Benefits:

By laparoscopic surgery, patients recovery will be early, hospital stay will be less, cosmetically good than open appendectomy. Double incision three port laparoscopic appendectomy is cosmetically better than conventional laparoscopic appendectomy with decreased post-operative pain and also time duration of surgery.

Voluntary participation/withdrawal:

Taking part in the study is voluntary. You may choose not to enroll yourself in this study. Your decision will not change present or future health care services offered to you at KLE'S DR. PRABHAKAR KORE HOSPITAL & MRC, BELAGAVI.

Alternatives:

Even if you decline the participation in the study, you will get the routine line of management

Privacy and confidentiality:

The only people to know that you are a research subject are members of the research team. No information about you or information provided by you during the research will be disclosed to other without your written permission except:

1. In emergency to protect your rights and welfare.
2. If required by law

Authorization to Publish Results:

When the results of the research are published or discussed, in a conference, no information will be displayed that would disclose your identity. Any information that is obtained in connection with this study and that can be identified with your identity remaining confidential

Financial incentive for participation:

No financial incentives are being offered to enrolled patients. It is purely done with the idea of research and all the cost of the study will be borne by the investigator.

Compensation:

In the event of injury related to the study, treatment will be made available through KLE'S DR. PRABHAKAR KORE HOSPITAL & MRC, BELAGAVI. There is no compensation or payment for such medical treatment by law.

Questions:

If you have any queries about your rights as a subject, you may call Dr. Ganga Pilli, Professor, Department of Pathology and Chairman J.N.Medical College Institutional Ethical Committee for Human Subjects Research, Phone number: 9480275601 or extension 4052 at J.N.Medical College, Belagavi.

"CONVENTIONAL LAPAROSCOPIC APPENDECTOMY VERSUS DOUBLE INCISION THREE PORT APPENDECTOMY: A ONE YEAR RANDOMIZED CONTROLLED TRIAL AT KLE'S DR. PRABHAKAR KORE HOSPITAL & MRC, BELAGAVI"

Consent for participation in research trial

I, Mr./Mrs./Miss. _____ voluntarily agree for the participation as a subject of study. By signing this consent form I am not giving up any of my legal rights, I may withdraw from the study anytime. I am signing the consent form after having read or been read for me in vernacular language, including the risks and the benefits and having all my questions answered.

Subject Name : _____

Signature or the Left Thumb Print of Subject: _____

Date:

Witness Name: _____ Signature: _____

Investigators Name: _____ Signature: _____

Guide:

Signature: _____

Date:

Place : _____

"CONVENTIONAL LAPAROSCOPIC APPENDECTOMY VERSUS DOUBLE INCISION THREE PORT APPENDECTOMY: A ONE YEAR RANDOMIZED CONTROLLED TRIAL AT KLE'S DR. PRABHAKAR KORE HOSPITAL & MRC, BELAGAVI"

Parent/Guardian Consent for participation in research trial

I, Mr./Mrs./Miss. _____ Parent/Guardian of_____ voluntarily agree for the participation of my child as a subject of study. By signing this consent form I am not giving up any of my legal rights, I may withdraw from the study anytime. I am signing the consent form after having read or been read for me in vernacular language, including the risks and the benefits and having all my questions answered.

Parent/Guardian Name : _____

Signature or the Left Thumb Print of Parent/Guardian: _____

Date:

Witness Name: _____ Signature: _____

Investigators Name: _____ Signature: _____

Guide:

Signature: _____

Date:

Place : _____

ANNEXURE II – PROFORMA

"CONVENTIONAL LAPAROSCOPIC APPENDECTOMY VERSUS DOUBLE INCISION THREE PORT APPENDECTOMY: A ONE YEAR RANDOMIZED CONTROLLED TRIAL AT KLE'S DR. PRABHAKAR KORE HOSPITAL & MRC, BELAGAVI"

Name: _____

Address_____

Age of the Patient: _____ IP. No. _____

Weight of Patient: _____

Sex. Male/Female

Anesthesiologist: _____ Surgeon unit/ Designation:

_____

PRE OPERATIVE EVALUATION:

Chief Complaints:

	YES/NO	DURATION
PAIN ABDOMEN		
SITE OF PAIN		

TYPE OF PAIN:	**YES**	**NO**	**RADIATING**
	THROBBING	**PRICKING**	**DULL ACHING**

INTENSITY:	**MILD**	**MODERATE**	**SEVERE**

	PRESENT	**ABSENT**
VOMITING:		

PRESENT	ABSENT	**FEVER:**

DURATION:

TYPE OF FEVER:	**CONTINUOUS**	**INTERMITTENT**	**SPIKING**

DEGREE OF FEVER:	**MILD**	**MODERATE**	**SEVERE**

PREVIOUS SURGERIES:	**YES**	**NO**

If, yes

What surgery has been done?

Past History:

- History of
- Diabetes Mellitus:- YES NO
- Hypertension:- YES NO
- Asthma:- YES NO
- Drug Therapy: YES NO

Family History:

General Physical Examination:

	Weight:
	Temperature:
	Pallor:
	Height
	Cyanosis:
	Pedal Edema:
	Clubbing:
	Lymphadenopathy:
	Icterus

BMI= Weight in **kg's**/ height in metres^2

= _____

	Pulse :
	B.P:
	RR:

SYSTEMIC EXAMINATION:

Per Abdomen:

PRESENT	ABSENT	TENDERNESS:

IF PRESENT, SITE

PRESENT	ABSENT	BOWEL SOUND

	NORMAL	ABNORMAL FINDINGS
Cardiovascular System:		
Respiratory System:		
Central Nervous system:		

INVESTIGATIONS:

Hb%: Urine Routine:

TLC:

DLC: N L E M B Platelet:

Creatinine: Urea:

PTINR:

LFT: Total bilirubin:

Direct bilirubin:

ASA STATUS: Grade 1 / 2

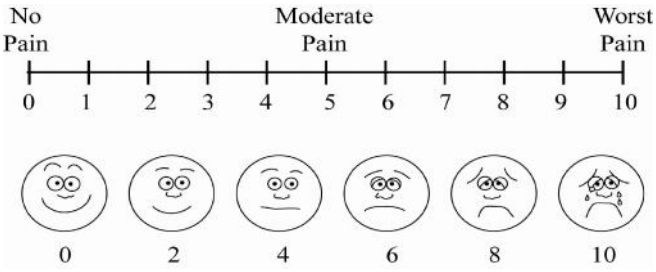
Diagnosis:

Proposed Surgery:

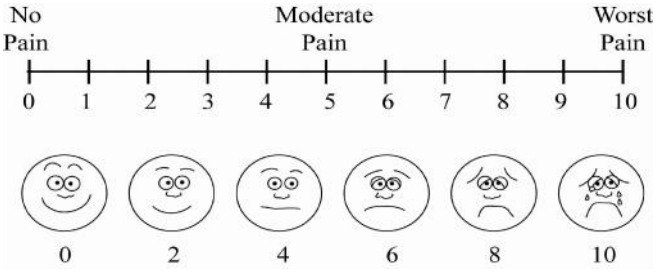
Duration of surgery:

Post operative pain:

1) **6 hours after surgery-**

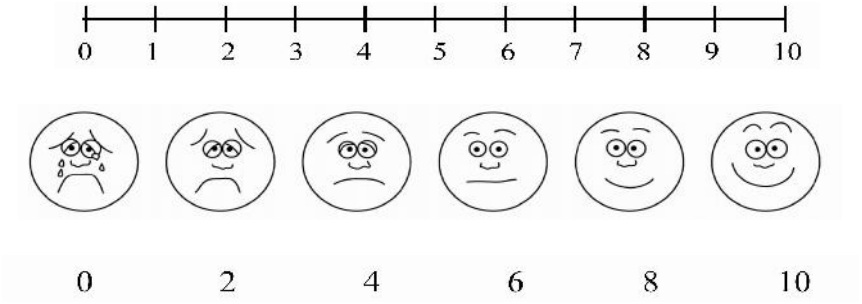


2) **24 hours after surgery -**



Cosmetic satisfaction

Not Satisfied **Satisfied**



ANNEXURE III

MASTER CHART

Sl.No.	IP. NO.	SEX	AGE	GROUP	DIAGNOSIS	DATE OF SURGERY	PROCEDURE PERFORMED	ADDITIONAL INTRA-OP FINDINGS	DURATION OF PROCEDURE(MINS)	PERI-OPERATIVE COMPLICATIONS	POST-OPERATIVE COMPLICATIONS	PAIN 6 HOURS AFTER SURGERY	PAIN 24HOURS AFTER SURGERY	COSMETIC OUTCOME
1	642627	M	15	A	AA	01/06/2015	CLA	-	25	-	-	6	6	10
2	643326	F	15	A	AA	01/10/2015	CLA	-	20	-	-	6	6	8
3	644372	F	20	B	AA	14/1/15	DILA	-	28	-	-	8	6	8
4	647734	M	17	B	AA	02/03/2015	DILA	-	34	-	-	6	4	10
5	648162	F	16	B	AA	02/05/2015	DILA	-	20	-	-	6	2	10
6	650699	F	40	B	AnCA	21/2/15	DILA	UMBILICAL HERNIA	37	-	-	6	6	4
7	652211	F	38	B	CA	24/2/15	DILA	LEFT OVARIAN CYST	38	-	-	8	4	9
8	651753	F	21	B	AA	24/2/15	DILA	-	25	-	-	6	4	10
9	652190	F	18	A	AA	28/2/15	CLA	-	16	-	-	6	4	10
10	652149	F	35	A	CA	28/2/15	CLA	ADHESIONS	14	-	-	6	4	10
11	656476	F	35	A	AA	19/3/15	CLA	LEFT OVARIAN CYST	25	-	-	6	4	10
12	657822	M	28	A	AA	28/3/15	CLA	-	20	-	-	4	2	8
13	660306	F	21	B	AnCA	04/11/2015	DILA	-	23	-	-	6	4	10
14	661042	F	25	A	AA	16/4/15	CLA	-	55	-	-	8	8	10
15	661570	F	27	B	AA	18/4/15	DILA	-	30	-	-	6	4	10
16	662017	M	28	B	AA	19/4/15	DILA	-	50	-	-	6	4	8
17	624143	F	28	A	AA	27/4/15	CLA	BULKY UTERUS	26	-	-	8	6	8
18	664590	M	40	A	AA	05/04/2015	CLA	-	20	-	-	6	2	10
19	664193	F	30	B	AnCA	05/02/2015	DILA	ADHESIONS	31	-	-	6	2	10
20	665459	M	38	A	AA	05/09/2015	CLA	MECKLE'S DIVERTICULUM	75	-	-	6	2	8
21	666838	F	15	A	AA	14/5/15	CLA	-	24	-	-	8	8	8
22	667181	F	31	B	CA	19/5/15	DILA	ADHESIONS	34	-	-	8	4	10
23	668352	F	26	B	AA	23/5/15	DILA	-	27	-	-	6	4	10
24	675084	F	55	A	AnCA	27/6/15	CLA	-	24	-	-	6	4	8
25	670635	M	21	B	AA	06/03/2015	DILA	-	26	-	-	6	4	8
26	670948	M	19	A	AA	06/09/2015	CLA	-	22	-	-	4	2	8
27	675057	F	17	B	AA	25/6/15	DILA	-	18	-	-	6	2	10
28	672006	F	30	A	AnCA	06/11/2015	CLA	BULKY UTERUS	20	-	-	6	4	10
29	672430	F	21	A	AA	13/6/2015	CLA	-	22	-	-	6	4	10

30	673681	F	42	A	AA	20/6/15	CLA	ADHESIONS + UMBILICAL HERNIA	24	-	-	8	4	6
31	673683	M	19	A	AA	20/6/15	CLA	-	18	-	-	4	2	8
32	676501	M	21	B	AA	07/04/2015	DILA	-	20	-	-	4	0	10
33	678005	M	30	A	AnCA	07/11/2015	CLA	-	26	-	-	6	4	10
34	677973	M	15	B	AA	07/11/2015	DILA	-	21	-	-	6	2	10
35	681285	M	25	A	AA	26/7/15	CLA	ADHESIONS	40	-	-	6	2	8
36	681953	F	17	B	AA	30/7/15	DILA	-	28	-	-	8	4	10
37	679775	M	16	A	AA	22/7/15	CLA	-	25	-	-	8	4	8
38	687674	F	29	B	AA	28/8/15	DILA	-	23	-	-	4	2	10
39	687607	M	60	A	AnCA	29/8/15	CLA	-	24	-	-	6	2	6
40	687615	M	33	B	AA	29/8/15	DILA	-	22	-	-	4	2	10
41	682237	M	26	B	AA	08/01/2015	DILA	UMBILICAL HERNIA	33	-	-	8	6	8
42	686906	F	32	A	AA	24/8/15	CLA	-	30	-	-	8	6	8
43	690298	F	60	B	AnCA	09/12/2015	DILA	ADHESIONS	42	-	-	6	6	8
44	695505	M	22	B	AA	10/08/2015	DILA	-	20	-	-	6	4	10
45	695793	F	24	B	AA	10/09/2015	DILA	-	19	-	-	8	6	8
46	696839	F	19	A	AA	15/10/15	CLA	-	23	-	-	6	2	10
47	696669	F	60	B	AA	15/10/15	DILA	ADHESIONS	32	-	-	6	6	8
48	694264	M	25	A	AA	10/02/2015	CLA	-	26	-	-	6	4	10
49	694091	M	18	B	AA	10/03/2015	DILA	-	21	-	-	6	2	10
50	695502	F	30	A	AA	10/08/2015	CLA	RT OVARIAN CYST	22	-	-	8	6	8
51	704008	F	15	A	AA	24/11/15	CLA	-	20	-	-	10	6	8
52	704718	M	15	B	AA	26/11/15	DILA	-	21	-	-	8	8	10
53	704670	M	32	A	CA	28/11/15	CLA	ADHESIONS	34	-	-	6	6	10
54	705191	M	15	B	AA	30/11/15	DILA	-	21	-	-	8	8	10
55	706022	M	15	A	AA	12/04/2015	CLA	-	25	-	-	8	6	10
56	706713	F	24	B	AA	12/07/2015	DILA		35	-	-	8	6	10
57	707328	F	18	B	AA	12/12/2015	DILA	-	23	-	-	6	2	10
58	707302	F	25	B	AA	12/12/2015	DILA	ADHESIONS	36	-	-	6	4	8
59	700747	F	28	B	AnCA	26/12/15	DILA	-	20	-	-	6	2	10
60	712725	F	35	A	CA	28/12/15	CLA	-	20	-	-	8	6	8

ANNEXURE IV

KEY TO MASTER CHART

Sl. No	-	Serial Number
M	-	Male
F	-	Female
IP. NO	-	In patient Number
AA	-	Acute Appendicitis
AnCA	-	Acute on Chronic Appendicitis
CA	-	Chronic Appendicitis
CLA	-	Conventional Laparoscopic Appendectomy
DILA	-	Double Incision Three Port Laparoscopic Appendectomy
Group A	-	Conventional Laparoscopic Appendectomy
Group B	-	Double Incision Three Port Laparoscopic Appendectomy