
“COMPARISON BETWEEN HAND SUTURING AND
CARTER-THOMASON NEEDLE CLOSURE OF PORT
SITES IN LAPAROSCOPIC SURGERIES. A ONE
YEAR RANDOMISED CONTROL STUDY IN KLE
DR. PRABHAKAR KORE HOSPITAL, BELAGAVI,
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LIST OF ABBREVIATIONS

Glossary	Abbreviations
BMI	body mass index
CAT	computerized axial tomography
DB	Dermabond
EFx	Endo Fascial Closure System
HWES	Hollander wound evaluation scale
LB	LiquiBand
OCA	Octylcyanoacrylate
TS	transcutaneous suture
VAS	visual analogue scale

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INTRODUCTION

The modern era of laparoscopy started in 1966 with the development of Hopkins-rod's system.¹ Since then many technological advancements have led to rapid evolution of laparoscopic techniques. These new techniques made it possible to perform a wide range of surgical procedures involving abdomen and pelvis. Laparoscopy allows for more intricate procedures to be performed with comparatively smaller abdominal incisions, reduced hospital stay and lesser post-operative complications as compared to open procedures.

But the laparoscopic methods are not without its associated complications. Port site hernias in laparoscopic surgeries have been frequently reported and complications related to port site closure have been subsequently increased from 0.2% to 6.3% of patients², and these complications include wound infection, herniation of small bowel, entrapment of omentum and incarcerated Richter's hernia^{2,3}. The incidence of these complications is reported to increase with the increase in port size and for trocar diameter of 10mm or more. The incidence of a hernia is reported to be 86% or more⁴.

Appropriate closure of the laparoscopy port sites is the vital aspect of laparoscopic surgeries is preventing these port site-related complications. It has been recommended by many studies that port sites of 10mm or more should be closed in adults and 5mm or more should be in children to minimize the port site-related complications.⁵

With the larger ports come larger abdominal incisions, and these have a lot of complications following surgery which includes incisional hernias and also small bowel obstruction⁶. The closure of laparoscopic trocar sites is helpful in reducing such

complications. Trocar complications occur approximately in 1-6% of the surgeries^{5, 7-14}.

Various types of port closure techniques have been evolved, parallel to the evolution of the laparoscopic techniques. These methods included, conventional hand suturing, adhesive tapes to newer suturing methods through specialized devices. Since the early age of laparoscopic ports has come, port site hernia has been reportedly increased in the incidence with the hand closure of trocar site. But the newer and improved techniques of wound closure are reported to minimize these complications, as compared to conventional hand closure of trocar sites. Carter Thomason port closure device is one such suturing system invented and tested by, but the number of controlled trials comparing “The Carter Thomason device suturing techniques” with the other available techniques is very limited.

Considering the increasing proportion of surgeries being performed laparoscopically and the importance of preventing the port site related complications, it is essential to have evidence based guidelines related to proper port closure techniques in specific populations. Controlled trials comparing the efficacy of various interventions are extremely vital in this regard. In this background, the present study has been conducted with the purpose of comparing the efficacy of Carter Thomason device port closure method with conventional suturing for laparoscopy port closure in preventing various port site-related complications. The study findings can enhance the strength of existing evidence on the subject and may contribute to the evolution of evidence based guidelines on the subject. So we carried out our study to compare the conventional hand suture technique and Carter-Thomason device technique for closure of port sites in laparoscopic surgeries.

OBJECTIVE

Primary Objective:

To compare between hand closure and Carter-Thomason device laparoscopic port closure technique with respect to following parameters,

- ✚ Time taken for port site closure
- ✚ Wound infection,
- ✚ Wound dehiscence,
- ✚ Seroma formation,
- ✚ Port site herniation and
- ✚ Ease of the procedure.

REVIEW OF LITERATURE

LAPAROSCOPY ORIGIN AND EVOLUTION

Swedish surgeon Hans Christian Jacobaeus is credited with coining the term “laparoscopy” (“laparothorakoskopie”). He began his animal experiments in 1901, inserting cystoscopes without pneumoperitoneum.¹⁵ He subsequently reported his clinical experience with 17 laparoscopies using pneumoperitoneum and 2 thoracoscopies in 1910.¹⁶

Boesch, a Swiss gynecologist, performed the first laparoscopic sterilization by electrocoagulation of the fallopian tubes.¹⁷ These breakthroughs paved the way for operative laparoscopy, but progress was very slow. The early slow pace of endoscopic and laparoscopic evolution was in large part related to the limitations of technology. It was further slowed by the skepticism of the medical and surgical communities. The early laparoscopic surgeons experienced many examples of repression by the old guard of traditional surgery.

During the mid-1950s to 1970s, further concerns were raised about a significant increase in complication rates due to bowel injuries and cautery injuries for women undergoing laparoscopic sterilization. During the mid-1960s and 1970s, gynecologist Kurt Semm in Kiel, Germany, contributed greatly to laparoscopic technology. He perfected many technical refinements, including an automated insufflator, the suction irrigator, safer electrocoagulation instruments, intracorporeal and extracorporeal knot tying, and an electrical morcellator for myomas.^{17, 18} In 1971, Harihasson, Gynecologist and SLS past president contributed to the safety of laparoscopy, developing the Hasson trocar with the open entry technique. In 1983, Kurt Semm performed the first laparoscopic appendectomy, bringing him criticism and censure rather than accolades. The German Board of Surgery condemned him.^{17, 19}

The first surgeon to perform a laparoscopic cholecystectomy met with a similar fate. German surgeon Erich Muhe used his “galloscope,” a 3-cm, direct-vision laparoscope of his own design to remove a gallbladder. He presented his work at the 1986 Congress of the German Surgical Society. He, too, suffered scepticism and criticism and was ultimately censored by the courts.¹⁷ The season for change had not yet arrived.

The single most important technological advancement for complex laparoscopic surgery would be the advent of video laparoscopy. In his SLS presidential address in 2005, Dr. Camran Nezhat described with considerable humor his early efforts suspending an unwieldy camera from the ceiling with duct tape and squinting at a low-resolution image on his monitor.²⁰

During the early to mid-1980s, videoscopic images were applied to endoscopy and ultimately to the laparoscope. The technology was now in place to support multiple people working in concert by laparoscopy. The term “minimally invasive surgery” was coined by English urologist Mr. John Wicker, who established a department of minimally invasive surgery at the Institute for Urological Surgery in 1983.¹⁶

Laparoscopic cholecystectomy was introduced to the general surgery world in the exhibit hall of the American College of Surgeons annual meeting in October 1989. Courses were organized by Reddick, Saye, and Olsen and soon by other pioneers in the field, proliferating to meet the frenzied demand from general surgeons worldwide. With no scientific evidence to support or justify the change from open to laparoscopic gallbladder surgery, the change did, in fact, occur almost overnight. Patients were demanding the new surgery, and instrument companies were supporting courses and even paying tuition for surgeons to be trained to use their products.

COMPLICATIONS FROM LAPAROSCOPY PORT SITES:

The incidence of incisional hernias is 0.23% at the 10 mm port site and 1.9% at the 12-mm port site. This incidence markedly increases to 6.3% for obese patients with a body mass index (BMI) greater than 30^{5,10}. An incisional hernia at a trocar site after laparoscopy may arise from infection, premature suture disruption, or failure to reapproximate fascial wound edges adequately. The condition is accurately diagnosed postoperatively at the physical examination. It typically is based on the presence of vomiting or nausea with an extended and painful abdomen within 2 weeks of surgery and can be established by a small bowel series. However, the course can be prolonged, and ileus can occur up to 1 year after laparoscopy²¹. A bulge at a previous port site should immediately raise suspicion. However, in obese patients, an incarcerated bowel loop in a trocar site can be easily missed. In case of suspicion, imaging of the abdominal wall is indicated to rule out a herniated bowel loop. An ultrasound scan may resolve any diagnostic doubts²², and several authors even recommend the use of a computerized axial tomography (CAT) scan²³.

A hernia at trocar ports is classified into three types:

1. The early-onset type (i.e., occurring immediately after the operation, with small-bowel obstruction (especially Richter a hernia) frequently developing,
2. The late-onset type (i.e., occurring several months after the operation, mostly with local abdominal bulging and no small-bowel obstruction developing [laparocèle]),
and
3. And the special type (i.e., indicating protrusion of the intestine and/or omentum)⁴.

The Richter a hernia usually presents days later, and the patients experience a delay in diagnosis due to the persistence of bowel function leading to significant morbidity. This complication of minimally invasive surgery is rare but potentially

dangerous. The usual presentation involves crampy abdominal pain with nausea and vomiting. Treatment is by reduction of the bowel that is incarcerated, followed by repair of the fascial defect. Although some authors advocate open repair or local exploration combined with laparoscopy, the laparoscopic approach is acceptable treatment at the time of diagnosis, as long as the incarcerated bowel is not compromised or frankly ischemic ²⁴.

INCIDENCE ²⁵

The incidence of PSH ranged from 0.38% to 5.4% with an overall incidence of 1.7% (it was seen in 99 of 5984 operations). The incidence was calculated by dividing the total number of PSH identified over the whole follow-up period by the number of patients in the study, expressed as a percentage. A difficulty with interpretation of the incidence is that PSH is often diagnosed late relative to the usual follow-up duration for LC, with many centers not offering any routine follow-up.

There are few prospective studies designed with the aim of identifying postoperative PSH. In these studies, the overall incidence was 3.2%. Three large studies published prior to 1995 were identified. The incidence of PSH reported in each study was 1 in 500 (0.20%)²⁶, 3 in 1983 (0.15%)²⁷ and 1 in 800 (0.13%)²⁸ respectively.

This equates to an overall incidence of 0.18%, which is considerably lower than that reported above in more recent studies. In one report, the study period was 9 months,¹⁹ and in the other 2, the study period was 15 months. Follow-up was not reported beyond the study period; therefore, only early hernias were identified through this means. There may also have been a lack of awareness of the complication because these articles reported the initial experience with LC.

LOCATION OF HERNIAS

The umbilicus was by far the most common port to be associated with an incisional hernia, being affected in 88 of 99 cases. However, hernias were observed at all other sites including the epigastrium (8 cases), the right hypochondrium (2 cases), and left hypochondrium (1 case)^{29,30}.

CLASSIFICATION

A classification⁴ of PSH into

1. Early (dehiscence of fascial planes and peritoneum),
2. Late (dehiscence of fascial plane with intact peritoneal hernia sac), and
3. Special (dehiscence of whole abdominal wall) types

has been described, but not widely used. No other article has attempted to classify PSH in any way.

CLINICAL PRESENTATION/MANAGEMENT

In the majority of cases, PSH is not associated with any strangulation or bowel obstruction. In cases of strangulation, the hernia is typical of a Richter's type.²⁹ Where omentum rather than bowel is the herniating tissue, patients tend to present later and with minimal symptoms.^{4,29} In a review study by Bunting et al²⁵, details of treatment were available in 38 of 99 hernias. Of these, 22 (58%) were operatively repaired. Two patients presented with small bowel strangulation (one with obstruction), one patient presented with a jejunal perforation associated with a strangulated hernia, and one patient had acute intestinal small bowel obstruction without strangulation.

TIME TO DIAGNOSIS

The interval between operation and diagnosis of PSH varies between studies and depends on follow-up regimes. When associated with few symptoms, they often

present late, and where data were available, time to diagnosis ranged from 5 days to 3 years with an average of 9.2 months²⁹.

PREDISPOSING FACTORS

Very few prospective studies have aimed at identifying the risk factors for PSH. No randomized studies have been performed to date. The factors predisposing to PSH can be divided into **Patient Factors** and **Operative Factors**.

PATIENT FACTORS

The presence of a preexisting umbilical/paraumbilical hernia has been identified in several reports as a risk factor for PSH.^{4,30,31}

Azurin et al³² retrospectively reviewed 1300 patients who underwent LC. Postoperative PSH developed in 10 patients, 9 of these occurred in patients who were found at operation to have incidental ventral midline hernias. These patients had umbilical closure with figure-of-eight polyglycolic acid sutures. When a hernia was symptomatic or identified preoperatively, it was repaired at the time of surgery with nonabsorbable, interrupted sutures. None of these patients developed postoperative hernias.

Nassar et al³⁰ found that 12% of patients undergoing LC had preexisting umbilical or paraumbilical defects, of which 83.7% were asymptomatic. Defects were closed at the end of the procedure with a polyglycolic acid suture repair in 90% of patients, the remainder having a nonabsorbable suture or formal hernia repair. Incisional PSH developed in 1.8% of patients, 25% of whom had a preexisting hernia with fascial closure at the time of surgery.

Male gender seemed to be associated with a higher incidence of a hernia in one report, without statistical analysis.³⁰ In another study, the incidence was higher in women on univariate analysis but not in the multivariate analysis.

Obesity has been suggested as a predisposing factor in some studies^{4, 31-33}, with one study reaching significance in multivariable analysis³³, but no statistical difference in others³⁴. The majority of studies did not assess the effect of body mass index (BMI) on the incidence of PSH. One study suggested that there may be a correlation with sudden weight gain and hernia development following surgery rather than obesity itself²⁹. Examination of incisional hernias can be more difficult to the obese patient,³⁵ which can give rise to late presentation and diagnosis.

In the study by **Coda et al**,³⁵ large-diameter gallstones have been proposed as a predisposing factor with 5 of 13 cases of PSH being associated with gallstones ranging from 2cm to 5cm in size. All these were removed via the umbilical port and would have required extension of the port-site incision, which has been identified as a risk factor in many other reports identified below.

A variety of medical comorbidities have been linked to hernias, including diabetes mellitus,^{30, 32} chronic obstructive pulmonary disease²⁹, renal failure³², and acquired immune deficiency syndrome³².

In one report, 9 out of 10 PSH were associated with comorbidities, although without statistical significance³². The presence of cholecystitis or recent malnutrition has been proposed as a possible causal factor in some studies without statistical testing^{29, 30}.

OPERATIVE FACTORS

Trocar diameter has been widely reported as a factor in the development of PSH.^{36, 37} In the review article of **Bunting et al**²⁵, out of the 99 cases identified, only 2 hernias were through ports 5mm in diameter, the remainder occurring in port sites 10mm in diameter. However, there are many other reports in the literature of herniation through 5-mm ports,^{13, 38} and indeed a single report of herniation through a

3-mm port site³⁹. Primary port insertion is either by a closed or open technique. The closed technique usually involves Veres's needle insufflation followed by blind insertion of a trocar. In the open technique (Hasson or similar), the abdominal wall is opened, and the port inserted under direct vision.

In a report on 373 patients, PSH only occurred in the closed insertion group³⁴. However, these patients only had closure of the fascia when the incision had to be extended whilst all patients in their “open” group had suture closure of the fascia. It has been suggested that in the case of closed insertion, even when the fascia is sutured, the incidence of PSH is higher. Fascial closure can be more difficult when the closed technique has been used, particularly in obese patients. However, in a nonrandomized study of 1300 patients, the incidence of a postoperative hernia was no different in the closed group (0.8%) compared with the open group (0.7%)³². The fascial closure was performed in all cases. None of the other studies was a suitable methodology to compare the 2 insertion techniques. Secondary ports are less often the site of hernia development, but hernias do occur at secondary port sites.

The type of trocar used is thought to be a determining factor^{31, 37}.

Broadly, they can be divided into 2 types:

1. Cutting trocars and
2. Dilating trocars.

The most common cutting trocars in use are reusable metal pyramidal trocars and disposable metal blade trocars with or without a sprung protective sleeve. They generally require less force to use but have a higher incidence of complications, such as bleeding, pain, and hernias. Dilating or “radially expanding” trocars bluntly separate abdominal wall tissues. They are thought to be associated with less bleeding and pain, although they require greater application of force to insert which could

increase internal organ injury. Newer hybrid designs have also been developed in an effort to minimize these problems.

Shafer et al³⁷ measured the size of the tissue defect created by a range of different trocar types in a porcine model. The functional and measured tissue defect was smallest for the hybrid and radially dilating trocars compared with cutting or plastic bladed trocars, suggesting that the former may be associated with fewer PSH. No controlled trials have been conducted that use different trocar designs in a clinical setting. Most series either use the same trocar design throughout or chose the type based on other patient/operative factors. In one study on 747 patients, 3735 port sites were created using a dilating trocar (VersaStep) without any occurrences of a hernia⁴⁰. Investigators encountered 9 PSH at Hasson ports used for induction of pneumoperitoneum. In another study, a bladeless, 12-mm visual entry trocar was used to gain access to the peritoneum and establish pneumoperitoneum in 849 gastric bypasses. The rate of PSH after 10 months was 0.2%. It must be remembered however that no specimens were extracted via the port sites.

Antoniou et al⁴¹ in their review of single-incision laparoscopic cholecystectomy identified 29 large studies and found a single PSH in 1166 patients (0.09%). Two Further studies identified no incidence of an incisional hernia in 80, and 29 patients⁴².⁴³ There are anecdotal reports that prolonged manipulation and reinsertion of ports are associated with a greater risk of herniation.²⁹ In the multivariate analysis by **Uslu et al**,³³ increased the duration of surgery was associated with an increased incidence of PSH. Many reports identify extension of the port incision to facilitate extraction of the gallbladder as a risk factor for PSH^{4, 29}. Though, in one study, none of the 10 patients with PSH had an extension of the incision.³² Some studies suggest there may be a greater incidence of herniation in the midline ports rather than off-midline ports^{44, 45},

however, others suggest this is not the case but rather larger diameter ports and extraction of the gallbladder are more likely to occur at the midline ports.⁴ Not closing the fascial defect is thought to be implicated in PSH formation,⁴ although closing the fascia is certainly not preventative. This is demonstrated by the fact that in some studies, hernias were identified despite fascial closure in all cases.⁴⁶

Mayol et al³⁴ found a trend towards a slightly higher incidence of a hernia in those who had ports closed; however, they were only closed when the port had to be extended for gallbladder removal. Unlike in most studies, **Uslu et al**³³ did not perform fascial closure in their series of 776 patients. In comparison, they identified a very high incidence of PSH at 5.4%. Whilst care has to be taken in drawing conclusions from this, it would suggest that not closing the fascia is at least partly responsible for their results.

One randomized trial involving 100 patients compared the use of a Berci fascial closure instrument (suture retrieval needle) with standard suture closure of the umbilical fascia⁴⁷. With 50 patients in each group, the study was too small to be of clinical relevance, and no patient in either group developed PSH. In the absence of any a preexisting hernia, there are no reports suggesting any method of suture closure is superior to another, although a poor closure technique has been identified as a contributory factor in individual cases²⁹. One institution has been using a Deschamps ligature needle for the fascial closure of trocar sites. This hand operated, reusable, blunt-tipped device can be used to close all port sites, including 5-mm ports and the final port. In their series of 1400 laparoscopic procedures, they reported no incidence of PSH⁵. Wound infection has been implicated in the pathogenesis of umbilical incisional hernia in some reports^{4, 29}. One randomized study investigating the effect of prophylactic topical rifamycin showed a reduction in incisional hernias with 2 of 24

patients in the control arm developing PSH (8%).⁴⁸ This incidence is very high; therefore, this work would need to be repeated before any conclusions are drawn. The use of a drain placed through a port site has been suggested as a risk factor for PSH in 2 studies, although this has not been fully evaluated³¹.

PORT SITE CLOSURE IN LAPAROSCOPY:⁴⁹

The introduction of laparoscopic surgery has brought with it new technical challenges. One of these is the closure of facial wounds when large trocars are used, or dilation of a 10-mm trocar wound for extraction of the gallbladder. Laparoscopic trocars do create wounds through which the bowel or omentum can find its way. Techniques and devices have been developed to minimize the risk of hernia formation.

Closure of these wounds generally is quite difficult and rarely complete due to the small opening of the skin. In 1968, **Fear**⁵⁰ was the first to report a ventral hernia at a trocar site after laparoscopy. Trocar complications occur in approximately 1% to 6% of patients⁴⁴. Herniation associated with laparoscopic trocar sites can occur with incisions as small as 3 mm³⁹. It is recommended that all 10- and 12- mm trocar sites in adults and all 5-mm port sites in children be closed, incorporating the peritoneum into the fascial closure³². Standard suture techniques can be difficult and frustrating, often involving the blind closure of the fascial defect. A number of techniques and devices have been developed to facilitate this fascial closure.

In addition to classical hand-sutured closure, other techniques could be classified from a technical point of view into three main groups based on the above review of the literature:

- (1) Techniques that use assistance from inside abdomen (i.e., requiring two additional ports: one for the laparoscope and one for the grasper),

- (2) Techniques that use extracorporeal assistance (i.e., needing only one additional port for the laparoscope), and
- (3) Closure techniques that can be performed with or without visualization. The efficacy and recurrence rates, advantages, and disadvantages of these techniques in the clinical realm need to be assessed by randomized trials. This is beyond the aim of this illustrative review.

CARTER-THOMASON DEVICE:

The Carter-Thomason Closure System^{51, 52} (Inlet Medical, Inc., Eden Prairie, MN, USA) is of two parts -

1. The Pilot guide and
2. The Carter-Thomason suture passer.

Closure of the port incision requires four easy steps:

- (1) Use the suture passer to push suture material through the Pilot guide, fascia, muscle, and peritoneum into the abdomen, then drop the suture and remove the suture passer),
- (2) Push the suture passer through the opposite side of the Pilot guide and pick up the suture,
- (3) Pull the suture up through the peritoneum, muscle, fascia, and guide, and
- (4) Remove the Pilot guide and tie

The Carter-Thomason suture passer also is available in an elongated version, the Carter-Thomason Close Sure System XL. The elongated version is designed specifically for bariatric and obese patients. The suture passer and Pilot guides have been lengthened to reach through the peritoneum in the larger patient to provide full-thickness closure in this at-risk group. **Lowry et al.**⁵³ reported a case of a port-site hernia at the insertion site for a 10 mm nonbladed trocar. Closure of the fascia at port sites is performed with the Carter-Thomason device. **Lowry et al.**⁵³ also commented that the procedure is straightforward and takes little time. The study by **Elashry et al.**² has shown that the Carter-Thomason CloseSure System facilitates the fastest trocar wound closure with 100% intraoperative success and no postoperative closure-related complications.

An endoscopic/laparoscopy procedure involves making small surgical incisions in a patient's body for the insertion of trocar tubes thereby creating access ports into the patient's body. Thereafter, various types of endoscopic/ laparoscopic instruments are passed through these access ports and the appropriate surgical procedures are carried out. After the surgical procedure is performed, the trocar tubes are removed and the incisions sutured closed by using both a needle and grasper for penetrating the tissue and handling the suture. This procedure for closure is frequently a time-consuming procedure requiring the identification of the fascia and closure of each fascial site with a suture from an external point. The necessity for closing these port sites in laparoscopic surgery is critical since suturing the incisions improperly can lead to bowel herniation through the port sites as well as the possibility of omental trapping if the fascial sites are not properly closed.

Incisional hernias have occurred in both laparoscopic-assisted vaginal hysterectomies and laparoscopic cholecystectomies as well as other advanced laparoscopic procedures. Thus there is a need for an endoscopic/laparoscopic instrument and method which will significantly reduce the operating time and is better able to give the surgeon direct visualization of the fascial and peritoneal closing. Additionally, there is a need for a surgical instrument which allows the surgeon to control bleeding sites by rapidly putting sutures around blood vessels of the abdominal wall. Furthermore, there is a need to accurately and consistently guide and orient an endoscopic/laparoscopic instrument into proper position to accurately and easily provide for placement and retrieval of suture materials within an open wound to be closed.

In 1995, a study was done by **Nakada S Y et al.**⁵⁴ (1995) on 32 patients undergoing transperitoneal laparoscopic procedures by randomizing them to receive

one of eight different port-site closure techniques with 12mm port sites. The port-closure techniques included: the Carter-Thomason Needle-Point Suture Passer, Maciol suture needle set, exit Disposable Puncture Closure device, Endoclose suture carrier, Tahoe Surgical Instruments Ligature device, a long 14-gauge angiocatheter with looped polypropylene suture, Lowsley retractor with hand-sutured closure, and the standard technique of hand-sutured closure. They evaluated the time, the security, and the auxiliary instrumentation required for each closure. Of the port-closure techniques, the Carter-Thomason device was faster overall, resulted in fewer port-closure-related complications and provided a leak-proof closure.

Di Lorenzo, N., et al. (2002) ⁵ observed that Trocar-site incisional hernias and complications related to them occurred in almost 1-6% of the patients and these hernias were caused by the difficulty of applying regular suturing techniques to wound closure. They used a device called Deschamps ligature needle. The Deschamps needle has both a handle and a tip (sharp/blunt) with an opening to pass suture. To close the trocar sites the blunt tip is very useful. The disposable needles are definitely sharp but there is a chance of a break in a deep small incision and also bend can happen on the needle holder.

The Deschamps needle is a rigid, noncutting instrument that can be forced through fascia and peritoneum (around the surgeon's fingertip) avoiding loss of pneumoperitoneum with which a full-thickness closure can be accomplished. They performed closure under direct vision through the scope, the Tactile sense was provided by the surgeon's finger and the last trocar site was closed in the same manner without the scope. They used the Deschamps needle since 1992 in all (1400) laparoscopic procedures. They closed 10-mm and 5-mm trocar sites and did not observe wound dehiscence or hernias at these sites. They concluded that Deschamps

needle was effective in preventing incisional hernias and wound dehiscence and was cost-effective and the real cost of this instrument was almost negligible.⁵

Matin, S. F. (2003) in their study evaluated whether the closure of laparoscopic port-site incisions using octylcyanoacrylate (OCA) is possible and whether it is faster than traditional subcuticular suturing methods and whether the number and length of incisions impact on closure time and also determined wound morbidity and patient satisfaction outcomes. They conducted a prospective randomized trial on adult patients scheduled for elective laparoscopic surgery in three surgical specialties at a tertiary referral center.

Patients were randomized to have closure of laparoscopic port sites using either OCA or sutures. Patients were followed up 2 to 3 weeks postoperatively. At 2 months patients were mailed a questionnaire regarding their satisfaction with the method of closure and the appearance of their scars. A total of 175 incisions in 50 patients were closed with OCA, and 142 incisions in 42 patients were closed with subcuticular sutures. Time to close was significantly faster for OCA (median 2.5 minutes versus 6 minutes, $p < 0.001$) and OCA was faster than traditional subcuticular suturing for cases involving three or more port sites (median 2.5 minutes versus 6 minutes, $p < 0.001$) and also for cases with total length of incisions >4 cm (median 2.6 minutes versus 7 minutes, $p < 0.001$). They observed that OCA and subcuticular suturing groups did not differ significantly on patient acceptance or assessment of scars. They concluded that closure of laparoscopic port-site incisions is feasible with OCA. Closure with OCA requires significantly less operative time than subcuticular suturing, particularly in cases when three or more port sites are used or when total incision length is greater than 4 cm. OCA appears to have equivalent adverse wound outcomes and patient acceptance rates as subcuticular suturing.⁵⁵

Laparoscopic trocars created wounds.

Shaher, Z. et al (2007) in his study reviewed and listed different techniques used for closure of the fascia incision at trocar sites. He conducted a literature search for articles dealing with closure techniques. He searched this subject in English on Medline by combining the words "trocar" and "a hernia," as well as "Deschamps" and "Reverdin." All articles reporting techniques with their references were reviewed. The articles described many techniques in addition to classical closure using curved needles, including Grice needle, Maciol needles, Endoclose device, Carter-Thomason device, Tahoe ligature device, Endo-Judge device, eXit puncture closure device, Lowsley retractor, spinal cord needles, dual hemostat, suture carrier, Riverdin and Deschamps needles, and Gore-Tex closure device. They concluded that three main groups of techniques were found with the favor of extracorporeal manipulations under direct visualization. Old methods were sufficient and cost-effective.⁴⁹

Fascial closure of port sites is a challenging issue in laparoscopic surgery.

Botea, F., et al. (2011) evaluated a simple technique for fascial closure after laparoscopy using a transcutaneous approach and standard surgical instruments for the suture. They observed that this method used in 34 patients who had no intraoperative incidents had no port-site hernias during a mean follow-up of 23.9 months (median 20.5, range 5 to 47) and concluded that this procedure was easy to perform, safe, fast, and inexpensive.⁵⁶

Aziz, H. H. (2013) in their study on 100 patients with no intraoperative incidents, additional operative time, or need to access costly instruments done as a prospective consecutive case series, used a simple new technique that was easy, cost-effective, and quick to apply using 2 S-retractors for suture placement under direct visualization to secure the abdominal wall fascia and peritoneum. This technique was also used by

many surgeons in their institution without any difficulty. This technique was used for fascial closure after laparoscopy ports > 8 mm using 2 S-retractors. One S-retractor was used as a barrier protecting the contents of the abdominal cavity, reducing the risk of visceral injuries. The second S-retractor allowed them to directly visualize the different layers, exposing the needle tip during its course through the fascia. Laparoscopic and robotic surgery is widely practiced in modern medicine. The operative procedure is not complete until the port sites are closed with a fascial suture. They concluded that this procedure was simple, easy, cost-effective, and quick to apply and No bowel injuries or port-site hernias were reported during a mean follow-up of 6 wk postoperation and 12-month annual follow-up.⁵⁷

Lasheen, A., et al. (2013) in their study evaluated a simple easy technique for fascial closure of port sites using a double-tip needle (Lasheen needle). Trocar-site incisional hernias are the most common complications in laparoscopic surgery. Fascial closure of port sites represents a challenging issue in laparoscopic surgery. In their study on 100 subjects who underwent laparoscopic surgery from January 2009 through August 2011 in the General Surgery Department, Zagazig University Hospital, Zagazig, Egypt observed that the mean age of the patients was 39.5 years, and the mean time for placement of one suture was 2 minutes. The mean follow-up period was 2 years for any wound complications at these trocar sites. They observed that no trocar-site herniation occurred with our technique during the period of follow-up. Infection developed at the trocar site in 3 patients. They concluded that their technique was easy, simple, safe, fast, inexpensive, and effective for fascial closure of trocar sites.⁵⁸

Del Junco, M., et al. in their study was to evaluate and compare a new trocars-site closure device, the WECK EFX Endo Fascial Closure System (EFx) with the Carter-Thomason CloseSure System(R) (CT) for the closure of laparoscopic trocar site

defects created by a 12-mm dilating trocar. They created standardized laparoscopic trocars-site abdominal wall defects in cadaver models using a standard 12-mm laparoscopic dilating trocar. Trocar defects were closed in a randomized fashion using one of the two closure systems. They recorded time and number of attempts needed for complete defect closure. They also recorded the ability to maintain pneumoperitoneum, endoscopic visualization, safety, security, and facility based on the surgeon's subjective evaluations. They compared the outcomes for the EFx and CT closure systems. In their study, Meantime needed for complete defect closure was 98.53 seconds (+/-28.9) for the EFx compared with 133.61 seconds (+/-54.61) for the CT (P<0.001). The mean number of attempts needed to achieve complete defect closure were 1.19 (1-3) for the EFx and 1.19 (1-2) for the CT (P=0.50). Mean scores for safety were 2.92 for EFx vs 2.19 for CT (P<0.001). Mean scores for the facility were 2.97 vs 1.83 for EFx and CT, respectively (P<0.001). Mean scores for maintenance of pneumoperitoneum were 1.97 for EFx vs 2.33 for CT (P=0.022). They observed no significant difference between the EFx and the CT systems for endoscopic visualization (2.28 vs 2.50, P=0.080). They concluded that in their In vitro cadaver trial, the EFx was superior in terms of time needed to complete defect closure, safety, and facility while CT was superior in terms of maintenance of pneumoperitoneum. Both systems were equal in the number of attempts needed to complete the defect closure and endoscopic visualization.⁵⁹

Kent, A., et al. (2014) in their prospective, randomized, controlled, double-masked, multi-center clinical trial compared the LiquiBand Surgical S (LB) (Advanced Medical Solutions Ltd, Plymouth, UK) with High Viscosity Dermabond (DB) (Ethicon Inc., Kirkland, Scotland) for the closure of laparoscopic wounds for the closure of laparoscopic incisions. The study was done in multiple district hospitals

with a total of 433 subjects enrolled between 2006 and 2009 at 4 investigational sites by comparing LB, an octyl/butyl cyanoacrylate blend, and DB, an octyl-based cyanoacrylate, for topical skin closure of laparoscopic port sites. They observed that high dermal apposition and cosmesis scores resulted from the use of both adhesives along with low rates of wound dehiscence and suspected infections. Masked evaluators and patients favored DB in the healing of the incisions (98.3% DB vs 93.9% LB, $p < .05$). But, there was no difference in the overall satisfaction of the appearance of the wounds. LB was found to be significantly ($p < .05$) faster (LB = 32.1 seconds; DB, 50.3 seconds) and easier to use than DB, and surgical users were significantly more satisfied with using LB for wound closure. They concluded that the efficacy of LB for the closure of topical skin incisions was higher and was significantly faster, easier to use, and resulted in greater user satisfaction compared with DB.⁶⁰

Shetty, A. and K. T. Adiyat (2014) in their study to compared between hand closure and Carter-Thomason technique with respect to time taken for port site closure, wound infection, wound dehiscence, seroma formation, port site herniation, and ascitic fluid leak in 200 subjects, undergoing laparoscopic donor nephrectomy by dividing them into two groups based on closure technique. First 100 cases underwent port closure by the standard hand closure technique and next 100 cases by Carter-Thomson needle technique. They included all subjects who are healthy individuals with no comorbid illness so as to reduce the bias of complications arising from other than a technical issue. They observed that in their study, Carter-Thomason served as a better mode of port site closure with respect to reduced time, wound and bowel related complications compared to hand closure technique and closure of trocar site

was better with the Carter-Thomason method when compared to hand closure technique.⁶¹

Buchweitz, O., et al. (2016) in their prospective randomized controlled trial evaluated the cosmetic outcome 3 months after a laparoscopic procedure and compared skin adhesive (SA) versus transcutaneous suture (TS). In an elective laparoscopic surgery, the cosmetic outcome becomes increasingly important. They conducted a randomized, controlled, prospective study at a single study center in Hamburg, Germany in Seventy-seven patients undergoing laparoscopic surgery with two lower abdominal port sites. They decided randomly which port site would be closed with SA and the opposite site was closed with TS. Wounds were assessed after 7-12 days and after 3 months. Cosmetic outcome was measured by a visual analogue scale (VAS) completed by the patient, by the Hollander wound evaluation scale (HWES) and by the judgment of blinded investigators. At the end of the study, Complete data from the 3-month follow-up visit were available from 56 patients (72.7 %). The VAS scale ranged from 0 to 100 mm with "0" representing the best possible cosmetic outcome. Median satisfaction was 2 mm in the TS group and 3 mm in the SA group. The mean was high in both groups 4.6 (s = 13.1) versus 3.8 mm (s = 4.6). The outcome was neither clinically nor statistically significant. Cosmetic outcome was assessed by an investigator, and the HWES showed no difference. In regard to complications, no difference was found between SA and TS, either. In conclusion, this study demonstrated that closure of laparoscopic port-site wounds leads to equivalent outcomes whether SAs or TSs are used and the observed Complications were rare in both methods. They concluded that SAs seem to be a valid alternative to sutures in laparoscopic surgery.⁶²

MATERIALS AND METHODS

Study site: The study was conducted in the department of general surgery in KLES Dr.Prabhakar Kore Hospital, Belgaum.

Study population: The study population included patients admitted and undergoing any laparoscopic surgery

Study design: Randomised Controlled trial of two different port closure techniques in patients undergoing the laparoscopic procedure.

- Group A- **Port closure using conventional hand suturing.**
- Group B- **Port closure using Carter Thomason device.**

Sample size: sample size was calculated assuming the mean time taken for port site closure in Carter Thomason group as 8 minutes as per study by Shetty A et al.⁶¹ standard deviation considered was 3 minutes. To be able to detect a minimum difference of 2 minutes between the two procedure, with an alpha error of 5% and 80% power of study, the total required sample size would be 43 subjects in each group. To account for loss to follow up another 10% of the subject were planned to be included, making the total required sample size as 48 subjects in each group. The final analysis has included 50 subjects in each of the intervention groups. The sample size was calculated using STATA IC software version 13.⁶³

Random allocation: Random allocation of study participants was done by generating an allocation sequence using random number tables, following pre-specification of single digit even and odd numbers to each of the intervention groups, after omitting zero.

Allocation concealment: Allocation concealment was done by securing the allocation sequence in serial numbered opaque envelopes in the custody of an

independent faculty. The allocation sequence was revealed to the investigator, after recruitment and obtaining informed written consent, just before intubation.

Blinding: Considering the nature of the intervention, it was not possible to blind the investigator. The participant blinding was also not possible as the nature of the intervention and the statistician analyzing the data was also blinded.

Sampling method: The study subjects were selected using purposive sampling technique.

Study duration: The data collection for the study was carried out 1ST January 2016 to 31ST December 2016

Inclusion Criteria

1. Patients admitted and undergoing any laparoscopic surgery
2. Age – 18 years and above

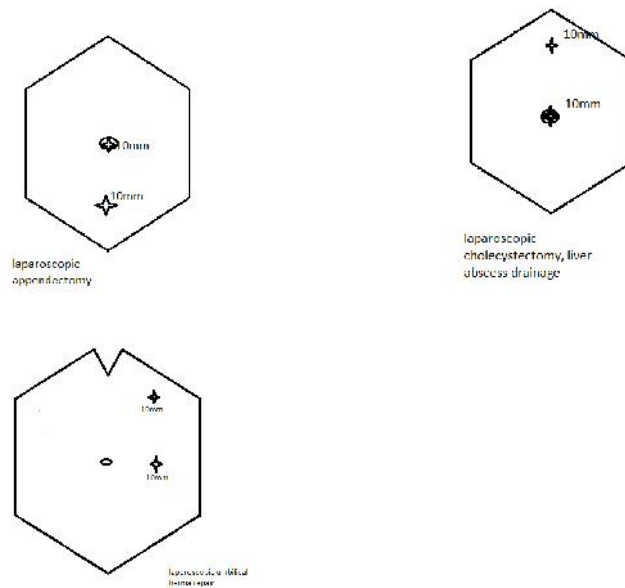
Exclusion Criteria

1. Patients who had previously undergone an open surgery.
2. Immunocompromised patients.
3. Bleeding disorders.

Study Procedure:

All the surgeries are done in both group A and group B were performed under general anesthesia. In both the groups, the umbilical port was placed by open Hassen's techniques, additionally, suprapubic ports were placed under vision in laparoscopic appendectomies, while epigastric ports were placed under vision in laparoscopic cholecystectomies, laparoscopic diaphragmatic hernias, laparoscopic liver abscess drainage etc.

Ports in umbilical hernia repair were placed at palmar's point and in the left lumbar region.



5mm ports not shown as they were placed as per requirement of the procedure.

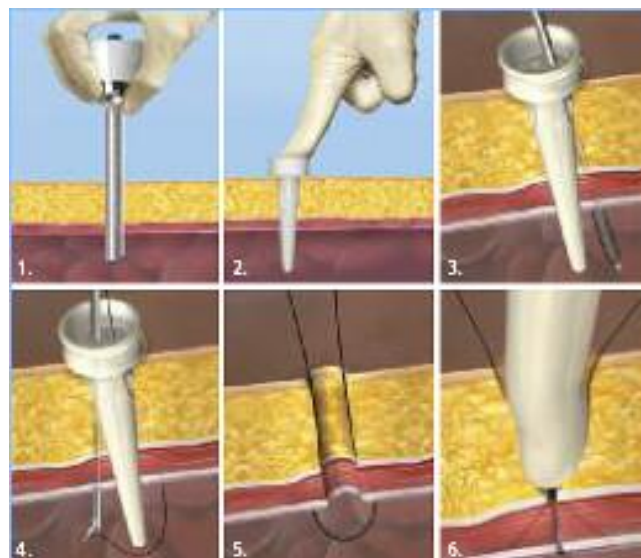
Minimum of 2, maximum 3 5mm ports were placed.

Group A

In this group at the end of every procedure, all the 10mm ports were closed using conventional hand suturing technique using vicryl 2-0 port closure suture, closing the rectus muscle and sheath. The skin is then closed using ethilon 3-0 suture.

Group B

Figure 1 CARTER THOMASON SUTURE DEVICE



In this group at the end of every procedure, all the 10mm ports were closed using Carter Thomason device under vision closing all the layers of the anterior abdominal wall (rectus, parietal peritoneum) closing the port completely without any air leak. In most cases, the umbilical port closed by introducing the camera in the suprapubic/ epigastric region depending on the type of the case. All the ports were closed using vicryl 2-0 port closure suture.

The pilot guide is first introduced into the umbilical port and using the help of Carter- Thomason suture passer the suture is introduced into the abdomen and suture released leaving the free end in the abdomen. Then the Carter Thomason suture passer is retrieved back. Carter Thomason suture passer is again introduced through another hole in the pilot guide which is 1cm beyond the opposite edge of the port entry site. The free end of the suture is then grasped by the Carter Thomason suture passer under the vision and then withdrawn from the abdomen. The sutures on both sides of the port are left alone while the camera is introduced through the umbilical port site, while the pilot guide is introduced into the suprapubic/ epigastric ports as per the case. The suture passer is passed into the abdomen wall similarly through the pilot guide leaving the free end of the suture in the abdomen, while the suture passer is retracted back. The suture passer was again introduced through another hole in the pilot guide which is 1cm beyond the opposite edge of port entry site, grasping the free end of the suture in the abdomen and withdrawn outside. Under pneumoperitoneum, both the sutures were held tight to confirm an air leak. Once confirmed, the pneumoperitoneum is released and the sutured were tied. The skin was closed using ethilon 3-0 suture.

Statistical methods:

Time taken for wound closure was considered as primary outcome variables. The occurrence of various port site related complications was considered as secondary outcome variables. The suturing technique was the primary explanatory variable. The age, gender, and presence of co-morbidities, BMI etc. were considered as other potential confounding variables.

Descriptive analysis: Descriptive analysis was carried out by mean and standard deviation for quantitative variables, frequency, and proportion for categorical variables. Data was also represented using appropriate diagrams like bar diagram, pie diagram, and box plots.

Both the study groups were compared with respect to all the baseline variables using mean and standard deviation for quantitative variables and frequency and proportion for categorical variables. Independent sample t-test and Chi square test were used respectively to test the statistical association.

The association between the suturing method and quantitative outcome variables was assessed by comparing the mean values. The mean differences along with their 95% CI were presented. Independent sample t-test was used to assess statistical significance. The association between explanatory variables and categorical outcomes was assessed by cross-tabulation and comparison of percentages. Odds ratio along with 95% CI are presented. Chi square test was used to test statistical significance.

P value < 0.05 was considered statistically significant. IBM SPSS version 22 was used for statistical analysis.⁶⁴

RESULT

A total 100 patients were included in the study, with 50 patients in group A (Conventional hand suture) and 50 patients in group B (carter Thomason suture)

Table 1: Comparison of mean of age between study groups (N=100)

Parameter	Group		P value
	Conventional hand suture (N=50) (mean \pm SD)	Carter Thomason suture (N=50) (mean \pm SD)	
Age	39.86 \pm 15.03	40.56 \pm 14.16	0.811

The mean age of conventional hand suture group was 39.86 years and Carter Thomason suture group was 40.56 years. The difference between two groups was statistically not significant (P value 0.811)

Figure 2: Bar chart of age distribution study group (N=100)

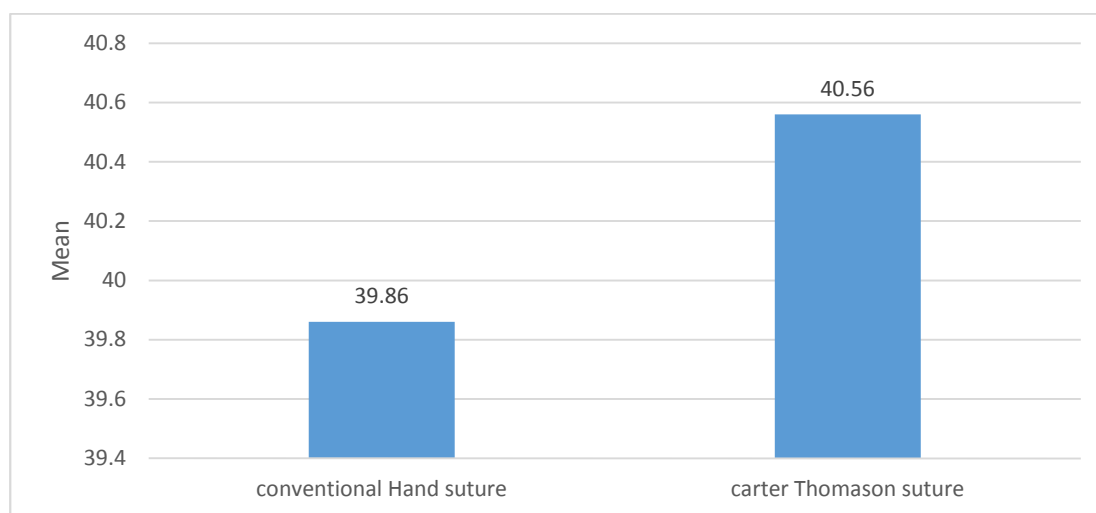


Table 2: Comparison of gender between study groups. (N= 100)

Gender	Group		Chi square	P-value
	Conventional hand suture (N=50)	Carter Thomason suture (N=50)		
Male	20 (40%)	27 (54%)	1.967	0.161
Female	30 (60%)	23 (46%)		

Among the conventional hand suture group, 20 (40%) were male and 30 (60%) were female. Among the Carter Thomason suture group, 27 (54%) were male and 23 (46%) were female. The difference between study groups in gender was statistically not significant (P value 0.161).

Figure 3: Bar chart gender distribution in study groups (N=100)

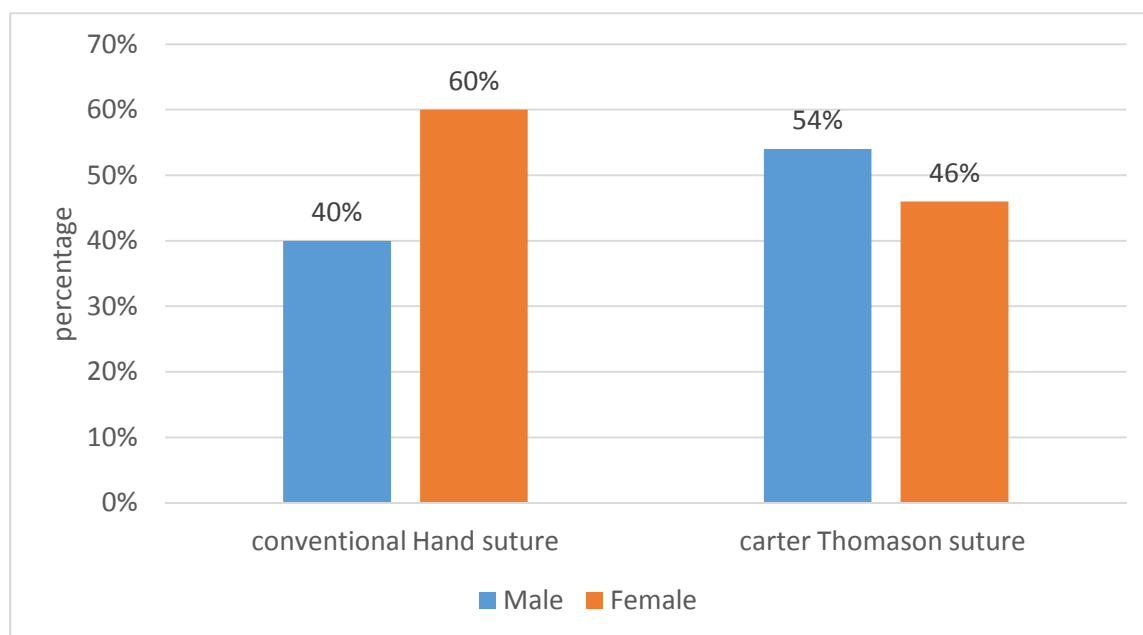


Table 3: Comparison of mean overall time taken for port closure between two study groups (N=100)

Time taken port closure (In minutes)	Mean ± STD	Mean difference	95% CI		P value
			Lower	Upper	
Conventional hand suturing	9.57 ± 2.27	5.30	5.99	4.60	<0.001
Carter Thomson device	4.27 ± 0.96				

The mean of overall time taken for port closure in conventional hand suturing group was 9.57 minutes and Carter Thomason device group was 4.27 minutes. The difference between two groups was statistically significant (P value <0.001)

Figure 4: Bar chart of time taken port closure distribution in study group (N=100)

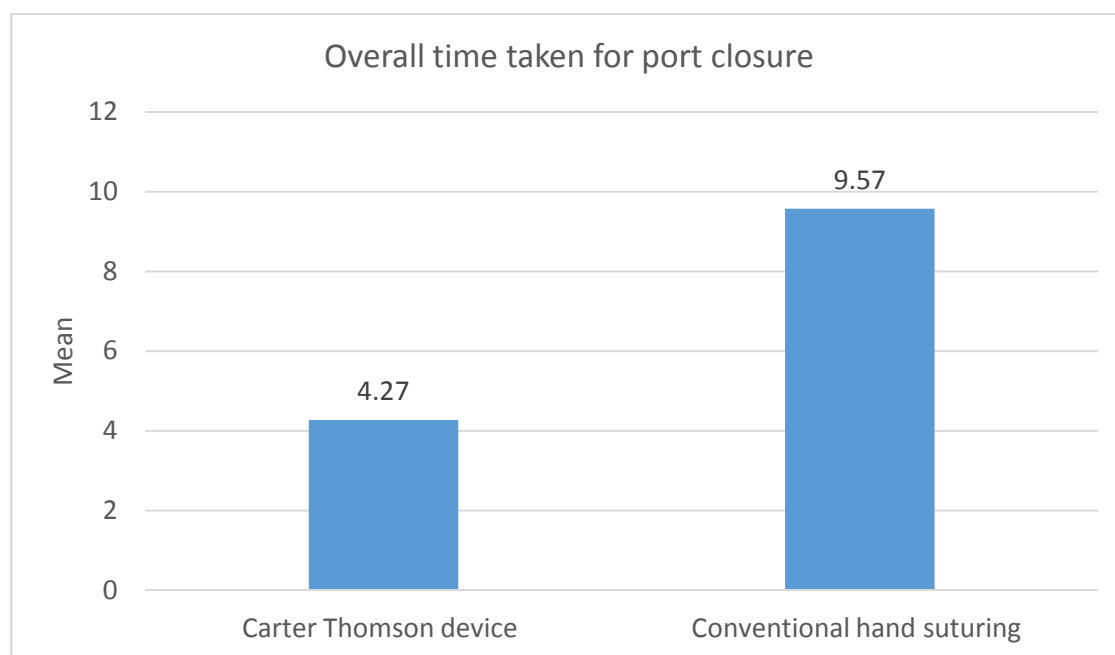


Table 4: Comparison of mean time taken for port closure min between two study groups (N=100)

Group	Mean time taken single port closure (min) Mean \pm STD	Mean difference	95% CI		P value
			Lower	Upper	
Conventional hand suturing	4.45 \pm 0.92	2.41	2.12	2.71	<0.001
Carter Thomason device	2.04 \pm 0.53				

The mean time taken for single port closure in conventional hand suturing group was 4.45 minutes and Carter Thomason device group was 2.04 minutes. The difference between two groups was statistically significant (P value <0.001)

Figure 5: Box and whisker plot of mean time taken for port closure min between study group (100)

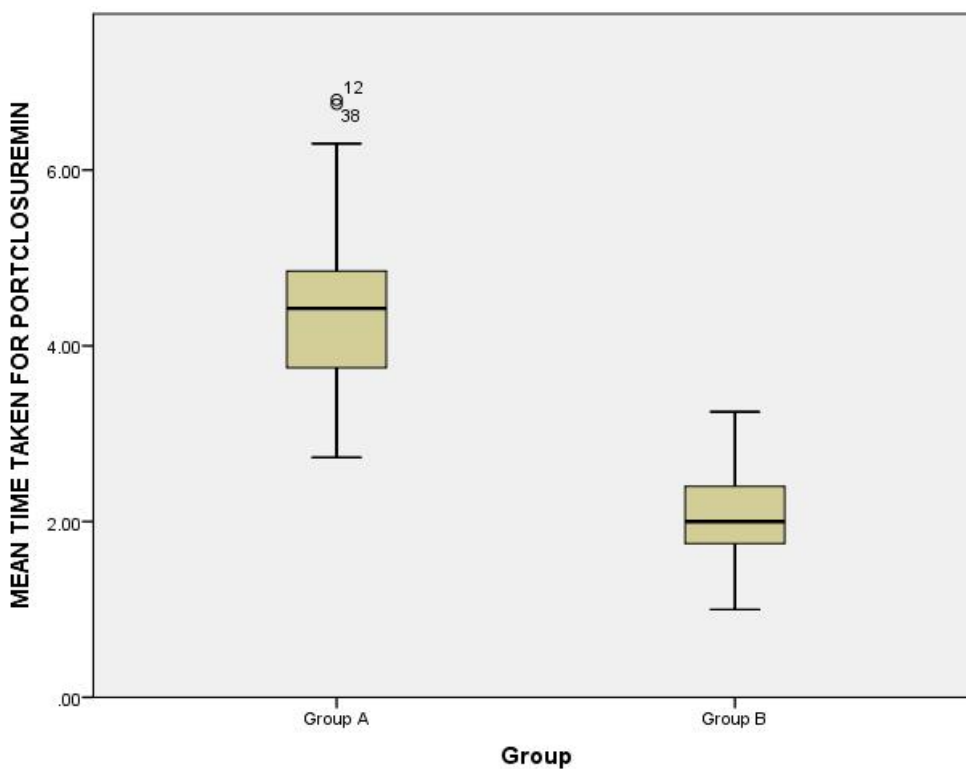


Table 5: Comparison of proportion seroma formation of between two study groups. (N= 100)

Seroma Formation	Group		Chi square	P-value
	Conventional hand suture (N=50)	Carter Thomson device (N=50)		
Yes	13 (26%)	6 (12%)	3.184	0.074
No	37 (74%)	44 (88%)		

Among the conventional hand suture group, 13 (26%) subjects had seroma formation. In the Carter Thomason suture group, 6 (12%) subjects had seroma formation. The difference between study groups in the proportion of subjects with seroma formation was statistically not significant (P value 0.074).

Figure 6: Bar chart of SEROMA FORMATION distribution in study group (N=100)

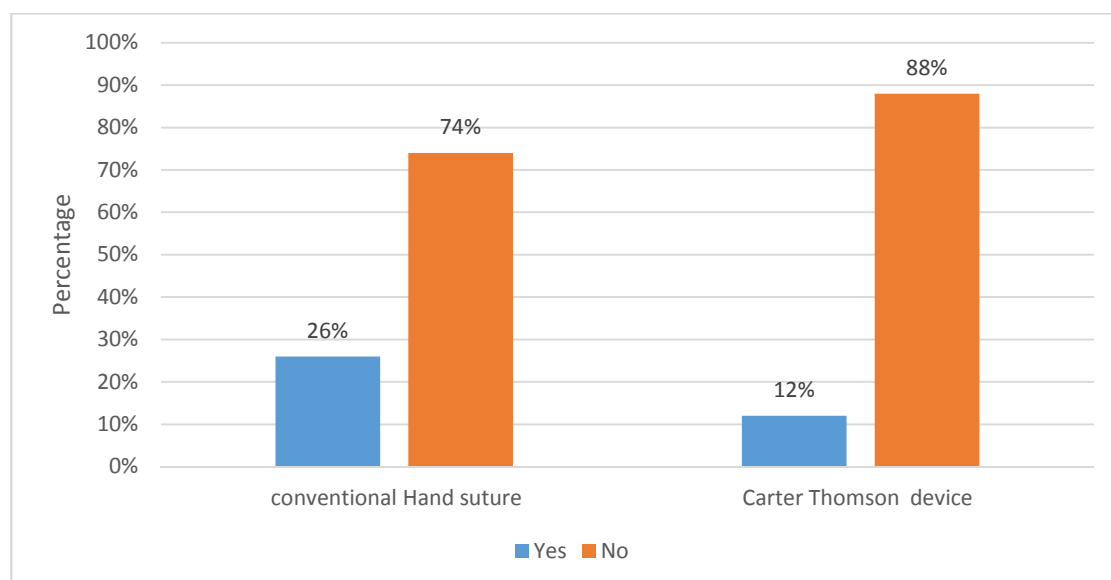
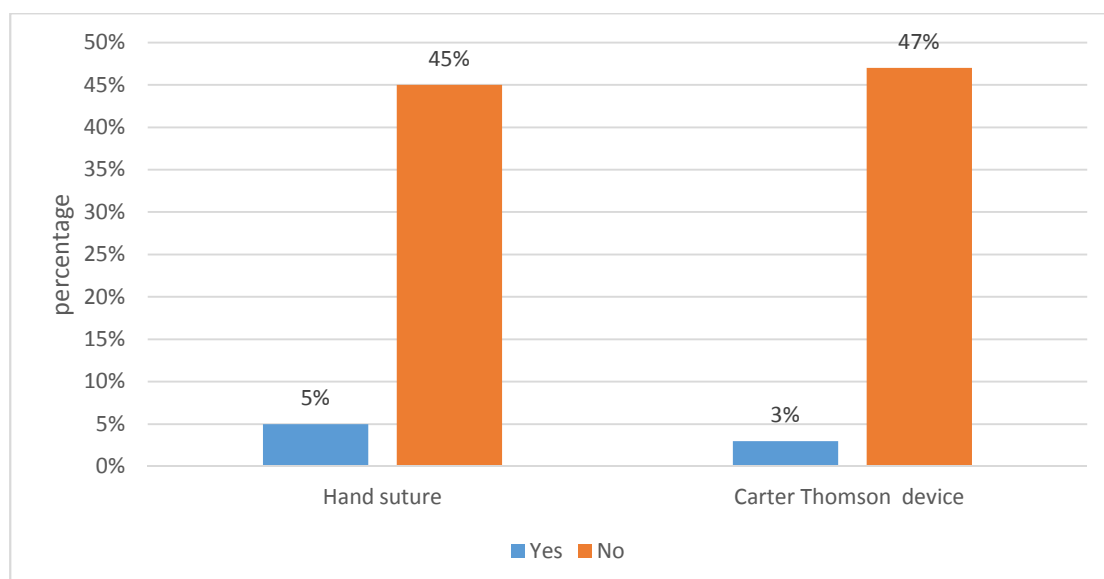


Table 6: Comparison of proportion wound infection of between two study groups. (N= 100)

WOUND INFECTION	Group		Chi square	P-value
	Conventional hand suture (N=50)	Carter Thomason suture (N=50)		
Yes	5 (10%)	3 (6%)	0.543	0.461
No	45 (90%)	47 (94%)		

Among the conventional hand suture group, 5 (10%) subjects had wound infection. In the Carter Thomason suture group, 3 (6%) subjects had wound infection. The difference between study groups in the proportion of subjects with wound infection was statistically not significant (P value 0.461).

Figure 7: Bar chart of WOUND INFECTION distribution in study groups (N=100)



Port site hernias

Early onset port site hernias were not seen within one year of our study.

Further evaluation required for knowing the better results.

DISCUSSION

In the modern era of medicine, Laparoscopic surgery is widely practiced. The operative process is not considered complete until all the port sites which are more than 8 mm are closed with a fascial suture. The Complications which occur most commonly due to port sites are most commonly incisional hernias^{49, 56} The incidence of these complications reported increase with the increase in port size and for trocar diameter of 10mm or more the incidence of a hernia was reported by 86% or more⁴. Various types of port closure techniques have been evolved, parallel to the evolution of the laparoscopic techniques. But the newer and improved techniques of wound closure such as Carter Thomason needle are reported to minimize these complications, as compared to conventional hand closure of trocar sites.

We did a randomised Controlled trial of two different port closure techniques in 100 patients undergoing the laparoscopic procedure under general anesthesia, selected by using purposive sampling technique from 1st January 2016 to 31st December 2016. They were randomised into groups of 50 each with Group A having port closure done with conventional hand suturing and in Group B- Port closure being done using Carter Thomason device.

In our study, we compared the 50 patients in Conventional hand suture group with 50 subjects in Carter Thomason suture group. The mean age of conventional hand suture group was 39.86 years while in Carter Thomason suture group, the mean age was 40.56 years and this difference between two groups was found to be statistically not significant (P value 0.811). Hence both the groups were comparable in terms of age in our study. Similar to our study, many other studies had middle-aged subjects as their study population. **Buchweitz O et al (2016)**⁶² in their study on the

Cosmetic outcome of skin adhesives versus transcutaneous sutures in laparoscopic port-site wounds in women found that the mean age of the 77 subjects was 35.6 years.

Lasheen, A et al (2013)⁵⁸ in their study to evaluate the Port-site closure using a modified Aptos needle randomly selected 100 patients (79 women and 21 men) with chronic calcular cholecystitis observed that the mean age of the patients was 39.5 years in the study with a range from 22 to 58. Hence the results of our study were comparable to other similar studies.

In our study, among the conventional hand suture group, 40% were males while 60% were females. The difference between study groups in gender was statistically not significant (P value 0.161). Hence the groups were comparable. Among the carter Thomason suture group, 54% were males and 46% were female. With regards to gender, **Nassar et al**³⁰ found that Male gender was associated with a higher incidence of a hernia, without statistical significance.³⁰ In another study, the incidence was higher in women on univariate analysis but not in the multivariate analysis.

The introduction of laparoscopic surgery has brought with it new technical challenges. Laparoscopic trocars do create wounds through which the bowel or omentum can find its way. Closure of these wounds generally is quite difficult and rarely complete due to the small opening of the skin. In our study, the mean overall time taken for port closure was higher in conventional hand suturing group compared to Carter Thomason device group. The mean time taken for all 10mm port closure in conventional hand suturing group was 9.57 minutes and in Carter Thomason device group, it was 4.27 minutes and the difference between two groups was statistically significant (P value <0.001)

Similar to our study, **Shetty, A. and K. T. Adiyat (2014)**⁶¹ observed that in their study, Carter-Thomason served as a better mode of port site closure with respect to reduced time in comparison to Hand closure. In their study, the overall mean time taken for port closure in conventional hand suturing group was 15 minutes with a range of 9 to 25 minutes while in Carter Thomason device group, it was 8 minutes with a range of 7 to 12 minutes and the difference between two groups was statistically significant (P value 0.02) In our study, the mean time taken for single port closure in conventional hand suturing group was 4.45 minutes with a range of 2.7 to 6.7 minutes and was significantly higher statistically than in the Carter Thomason suture group where it was only 2.04 minutes with a range of 1 to 3.2 minutes. The difference between two groups was statistically significant (P value <0.001)

Similar to our study, **Elashry O M et al (1996)**² in their study comparing seven new laparoscopic port-closure techniques including the Carter-Thomason Needle-Point Suture Passer with the standard technique of a hand-sutured closure also observed that the Carter-Thomason device was the preferred method with reference to time taken for the closure of port sites after laparoscopic surgery. But, **Del Junco, M et al**⁵⁹ in their study on In vitro cadaver trial, concluded that the Endo Fascial Closure System (EFx) was superior in terms of time needed to complete defect closure compared with the Carter-Thomason Closure System for the closure of laparoscopic trocar site defects created by a 12-mm dilating trocar. In their study, Meantime needed for complete defect closure was 133.61 seconds (+/-54.61) for the CT (P<0.001). The mean number of attempts needed to achieve complete defect closure were 1.19 (1-2) for the CT (P=0.50). But they did not compare with the conventional Hand suturing group. In our study, among the conventional hand suture group, 13 (26%) subjects had seroma formation while in the Carter Thomason suture group 12%

subjects had seroma formation. This difference between study groups with regards to the proportion of subjects with seroma formation was statistically not significant (P value 0.074).

Wound infection has been implicated in the pathogenesis of umbilical incisional hernia in some reports^{4, 29}. One randomized study investigating the effect of prophylactic topical rifamycin showed a reduction in incisional hernias with 2 of 24 patients in the control arm developing PSH (8%).⁴⁸ The use of a drain placed through a port site has been suggested as a risk factor for PSH in 2 studies, although this has not been fully evaluated³¹. In our study, among the conventional hand suture group, 40% (5) of subjects had wound infection while in the Carter Thomason suture group 6% (3) of subjects had wound infection. This difference between study groups was also statistically not significant (P value 0.461).

Similar to our study, **Shetty, A. and K. T. Adiyat (2014)** also observed that Carter-Thomason served as a better mode of port site closure with the reduced wound and bowel related complications compared to hand closure technique and closure of trocar site was better with the Carter-Thomason method when compared to hand closure technique.⁶¹ Wound infection was observed in 2 subjects out of the 100 in hand closure technique in their study, compared to only one in Carter-Thomason group. The wound site infection rates reported by this study were 2% in hand closure group and 1% in Carter Thomason device port closure group were much lower than what is observed in the current study .

Elashry et al.² in their study, showed that the Carter-Thomason Closure System facilitates the fastest trocar wound closure with 100% interoperative success and no postoperative closure-related complications. In contrast to evidence from our study, **Del Junco, M et al.**⁵⁹ in their study in their In vitro cadaver trial, concluded that the

Endo Fascial Closure System was superior in terms of time needed to complete defect closure, safety, and facility while Carter-Thomason Closure System was superior in terms of maintenance of pneumoperitoneum. Both systems were equal in the number of attempts needed to complete the defect closure and endoscopic visualization⁵⁹ but they did not compare it with the conventional hand suturing technique.

The incidence of incisional hernias varies from 0.23% at the 10 mm port site to 1.9% at the 12-mm port site and this incidence also markedly increases to 6.3% for obese patients with a body mass index (BMI) greater than 30^{5, 10}. Cause of trocar site hernias is mainly attributed to large trocar size, incomplete fascia closure at the trocar site, midline trocars, trocar site stretching, suction effect while port withdrawal, being overweight, malnutrition and vitamin and mineral deficiencies are known factors. In the study by **Coda et al**,³⁵ large-diameter gallstones have been proposed as a predisposing factor with 5 of 13 cases of PSH being associated with gallstones ranging from 2cm to 5cm in size. All these were removed via the umbilical port and would have required extension of the port-site incision, which has been identified as a risk factor in many other reports identified below. In our study, the port site hernias couldn't be assessed for more than 6 months as our study period was limited to one year. No early onset port site hernias noted in our study. Furthermore, evaluation to be done for assessment of late-onset port site hernias.

A variety of medical comorbidities have been linked to hernias, including diabetes mellitus,^{30, 32} chronic obstructive pulmonary disease²⁹, renal failure³², and acquired immune deficiency syndrome³². In our study, under the context and situations done, we could not evaluate the whole range of etiological factors which has been studied extensively and adequate knowledge is already available. So, we focused mainly on the time taken under the setting of a tertiary care hospital in India.

In our study, Seroma formation and Wound infection were higher in Conventional Hand suturing group compared to the Port closure with Carter-Thomason group.

CONCLUSION

1. The demographic profile of the study population showed the mean age of the subjects to be about 40 years with no statistical significant difference between the intervention groups
2. Even though there were differences in proportion of males and females between the two intervention groups, they were statistically not significant. In conventional suturing group only 40% were males and this proportion was 54% in Carter Thomason suture group.
3. The ease of procedure was higher for Carter Thomason device port closure group, as compared to conventional hand suturing group as both overall time for port closure (4.27 ± 0.96 Vs 9.57 ± 2.27 minutes, P value < 0.01) and time taken for single port closure (2.04 ± 0.53 Vs 4.45 ± 0.92 , P value < 0.001) were significantly lesser in Carter Thomason suture group.
4. The post-operative complications like seroma formation and wound site infection were lesser in Carter Thomason suture group, as compared to conventional suture group. But these differences did not attain statistical significance.
5. At the end of the follow up period none of the subjects in either of the intervention groups, did not develop any early onset port site herniation within 6 months, as our study was limited to one year.

LIMITATIONS:

1. The key limitation of the current study is relatively smaller sample size, due to which the potential role of confounding factors like gender could not be evaluated by appropriate regression statistics. Proper evaluation of the role of all relevant confounding factors would have made the study findings more valid.
2. Even the lack of statistical significance in the difference observed between the two in proportion of post-operative complications could also be attributed to smaller sample size.

RECOMMENDATIONS:

1. Carter Thomason suture device is relatively easy to use, consumes lesser amount of surgeon's time and causes relatively lesser proportion of complications, the port is closed in all layers under vision with help of Carter Thomason port closure device, hence can be preferred over conventional hand suturing.
2. There is a strong need for further large scale prospective studies to understand the efficacy and safety in different population sub groups. Also there is need to conduct cost effectiveness studies to recommend it for routine use in resource limited settings.
3. There is also need to further evaluate for late onset port site hernias , since the present study is restricted to one year.

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ANNEXURE - I - INFORMED CONSENT

Title of the Research Study: Comparison between Hand Suture and Carter-Thomason Needle Closure of Port Sites in Laparoscopic surgeries. A one year Randomised control study, comparative study in KLE Dr. Prabhakar kore hospital, belagavi, Karnataka.

Principal Investigator:

DR. _____

Professor,

Department Of General Surgery,

J. N. Medical College, Belagavi.

Co-investigator:

DR. _____

Post Graduate Student,

Department Of General Surgery,

J. N. Medical College, Belagavi

Introduction:

Dear Mr./Mrs./Miss/_____, you are kindly requested to participate in a research study titled “**Comparison between Hand Suture and Carter-Thomason Needle Closure of Port Sites in Laparoscopic surgeries. A one year Randomised control study, comparative study in KLE Dr. Prabhakar Kore Hospital, Belagavi, Karnataka**” conducted by Dr. _____, post graduate student in M.S. General Surgery in Jawaharlal Nehru Medical College, Belgaum, under the direct supervision and guidance of Dr. _____, Professor, Department of Surgery, J. N. Medical College, Belgaum.

OBJECTIVE/PURPOSE OF THE STUDY:

Recently a number of laparoscopic surgeries are being done. A number of port closure complications had been reported. The purpose of this study is to reduce the complications associated with the laparoscopic port closure and to compare between hand closure and Carter-Thomason technique of port closure with respect to following parameters, time taken for port site closure, wound infection, wound dehiscence, seroma formation, port site herniation, and ascitic fluid leak.

The investigator/author of this study is Dr. _____, a postgraduate student in the Department of General Surgery, Jawaharlal Nehru Medical College under the direct supervision of Dr. _____, Professor, Department of General Surgery, Jawaharlal Nehru Medical College. The study is self-funded by the author the study.

You need to be eligible, meeting all the selection criteria to participate in this study. You should be willing to provide information about yourself. 60 subjects will be enrolled in this study who will then be randomized in either of 2 groups (details below).

PROCEDURE:The Carter Thomason device is of two parts 1.) Pilot guide and 2.) Carter Thomason suture passer. Closure of the port incision is of four easy steps. a) Use the suture passer to push suture material through the pilot guide, fascia, muscle and peritoneum into the abdomen, then drop the suture and remove the suture passer (b) Push the suture passer through the opposite side of the pilot guide and pick up the suture (c) Pull the suture up through the peritoneum, muscle, fascia, and guide (d) remove the pilot guide and tie the suture.

BENEFITS: The benefits of the procedure under study are early faster closure, better cosmesis & minimum complications.

RISKS: There is no additional risk as compared to the standard treatment.

VOLUNTARY PARTICIPATION / WITHDRAWAL: Taking part in this study is voluntary; you may choose not to enrol in this study. Your decision will not change the present or future health care services offered to you at KLES Dr. Prabhakar Hospital, Belgaum. You would simply be excluded from the study and all your details shall be kept confidential. The alternative that you have is to undergo the traditional procedure that is carried out in KLES Hospital.

PRIVACY & CONFIDENTIALITY: Every effort will be made to protect the confidentiality of the information you provide. This means that the researchers will not let anyone, not a part of the study, see the information you provide. Only Dr. _____ and Dr. _____ will have access to the information collected. Results of this study may be published but your name will not be revealed.

AUTHORIZATION TO PUBLISH RESULTS: The results of the study may be used to publish an article. When the results of research published or discussed, in a conference, no information will be displayed that would disclose your identity. Any information obtained in connection with this study and that can be identified with you will remain confidential.

FINANCIAL INCENTIVES FOR PARTICIPATION: No additional costs shall be incurred upon you for the purpose of this study. It is purely being done with the idea of research and all the cost of study will be borne by the investigator.

COMPENSATION: In the event that you become injured as a result of taking part in this study, treatment will be offered to you at KLES Dr. Prabhakar Kore Hospital and Medical Research Centre, Belgaum, or you will be given information about where to receive medical care in which case you/your insurance company will be responsible for the costs. However, no reimbursement, compensation or free medical care will be given. There is no compensation or payment for such medical treatment by law.

CONTACT DETAILS: If you have any queries about the study, you may contact Dr. Guttikonda Varun (Mobile No _____) or Dr. _____
_____. If you need any further information regarding your rights as a study participant, you may also contact Dr. Ganga Pilli (Mobile no. _____) Chairman of Institutional Ethics Committee, JNMC, Belgaum.

Dr. _____

M.B.B.S

Post Graduate Student (M.S.)

Department of Surgery

Jawaharlal Nehru Medical College

KLE University

Belgaum 590 010

Mobile No.: _____

CONSENT STATEMENT:

I the undersigned Mr./Mrs./Miss/_____ do hereby give consent for my participation in this research study after being explained in-depth about the important elements of this study in own my vernacular language.

I voluntarily agree to participate in this study by signing up this form below. I understand that I may withdraw at any time from this study. I have been given adequate time to clarify my doubts about the study and my rights as a study participant.

My signature / left thumb impression below indicates that I have read or information in the consent been read to me including the risks and benefits and have cleared my doubts.

I do hereby also give consent for publication of this article in any media / journal and have no objections whatsoever.

Signature or left thumb impression of participant or legally authorized representative

Participant's name_____

Signature/LTI_____

Investigator's name_____

Signature/LTI_____

Witness' name_____

Signature/LTI_____

Date ___/___/___

Time: am/pm

Place:

ANNEXURE - II - PROFORMA

The proposed pro forma / questionnaire to be used for data collection for the study titled “**Comparison between Hand Suture and Carter-Thomason Needle Closure of Port Sites in Laparoscopic surgeries. A one year Randomised control study, comparative study in KLE Dr. Prabhakar kore hospital, belgaum, Karnataka.**” is as follows-

1. PATIENT IDENTIFICIATION DATA

Group:		Ward:
Name:		IP No.:
Age:	Sex:	D.O.A:
Address:		D.O.S:
		D.O.D:
Education:		
Religion:		Marital Status:
Occupation:		Socio-Economic Status:

2. Chief Complaints:

3. History of Presenting Complaints:

4. Past History:

5. Personal History:

6. Family History:

7. GENERAL PHYSICAL EXAMINATION:

Built and Nourishment:

Weight:

Pallor / Icterus / Cyanosis / Clubbing / Oedema / Lymphadenopathy

Vital Signs: PR: /min; BP: mmHg; RR: /min; Temp: °C

8. Systemic Examination:

Abdomen:

Inspection:

Palpation:

Percussion:

Auscultation:

Cardio Vascular System:

Respiratory System:

9. Clinical Impression:

10. Investigations:

Blood - Routine : Hb: Total Leucocyte Count:

Platelet count:

Random blood sugar :

Blood urea. :

Sr. Creatinine. :

LFT's :

Bleeding time :

Clotting time :

Urine routine and microscopy:

11. Operation Details:

Date of Surgery:

Name of Surgery:

Anaesthesia: General Anaesthesia

Duration of Surgery:

BUDGET ESTIMATION

Title: Comparison between Hand Suture and Carter-Thomason Needle Closure of Port Sites in Laparoscopic surgeries. A one year Randomised control study, comparative study in KLE Dr. Prabhakar kore hospital, belgaum, Karnataka.

1. Personnel	:	Not Applicable.
2. Consultant's	:	Not Applicable.
3. Equipment		Available in the ward/operation theatre.
4. Supplies		Not Applicable.
5. Subject Cost	:	Not Applicable.
6. Travel	:	Not Applicable.
7. Other Expenses		a. Stationery – 2000/- b. Synopsis, informed consent, Pro forma, collection of articles – 3000/- c. Printing of dissertation – 15000/- d. CD-ROM – 500/-
8. Total Direct cost		0/-
9. Total Indirect cost		20,500/-
10. Combined total		20,500/-

TIME PLAN

Title: Comparison between Hand Suture and Carter-Thomason Needle Closure of Port Sites in Laparoscopic surgeries. A one year Randomised control study, comparative study in KLE Dr. Prabhakar kore hospital, belgaum, *Karnataka*.

PHASE	TIME PERIOD	OUTLINE OF PLAN
I.	July 2015 To December 2015	1. Identification of the problem – 1 month
		2. Review of Literature – 1 month
		3. Development of Pro forma – 1 month
		4. Submission of Synopsis – 1 month
II.	January 2016 To December 2016	Data Collection – 12 months
III.	January 2017 To June 2017	Analysis of data – 2 months
		Discussion – 4 months
IV.	September 2017	Submission of Dissertation

Annexures

Annexure III



ANNEXURE III – PHOTOGRAPH

1

Fig 2. Carter Thomason suture passer with vicryl suture, closing the umbilical port

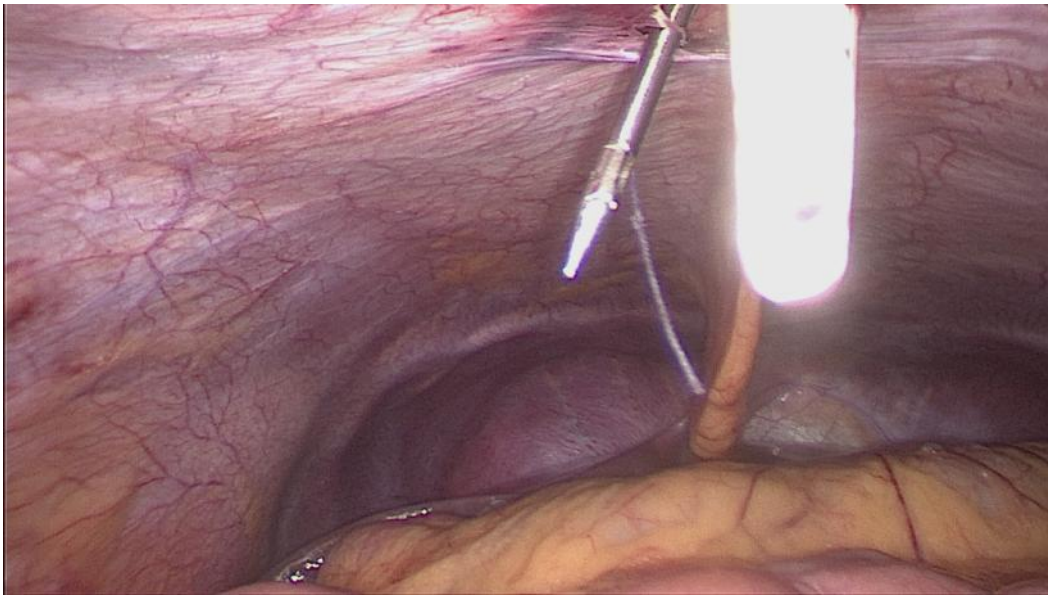
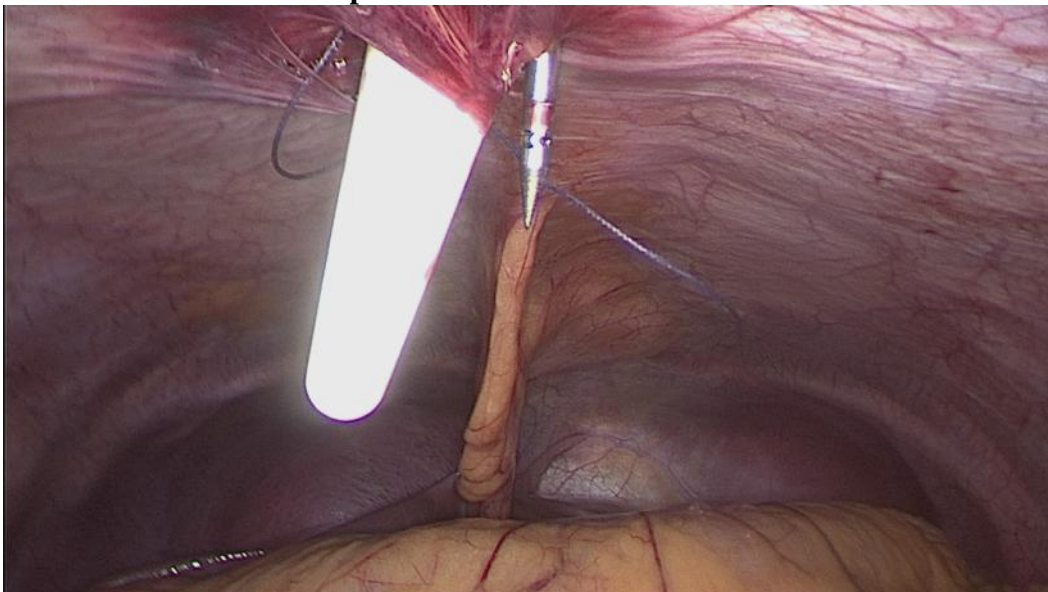


Fig 3. Photograph showing retraction of suture by the second entry of the Carter Thomason suture passer



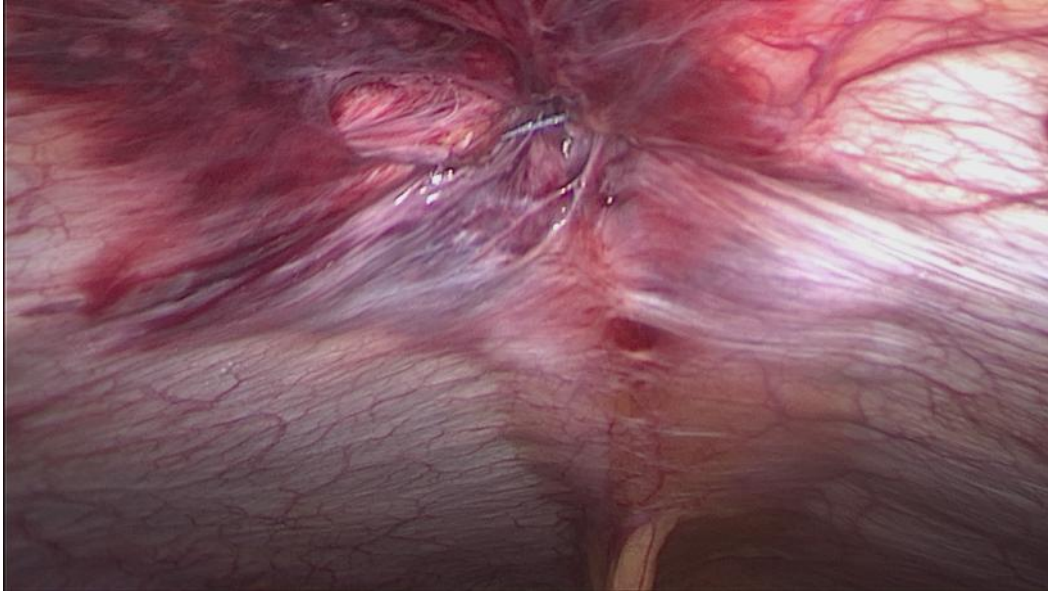


Fig 4. Photograph showing closure of umbilical port with all layers of abdomen including the parietal peritoneum.

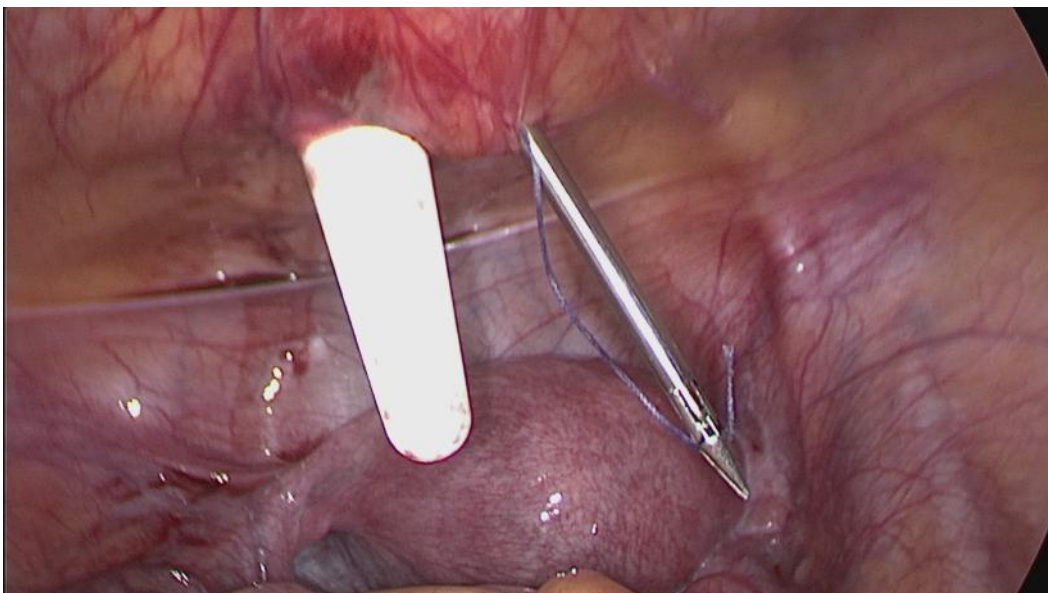


Fig 5. Photograph showing closure of the suprapubic port(10mm) using Carter Thomason device in LA.



Fig 6



Fig 7. Photograph showing pilot guide with two entries of Carter Thomason device for suture passer .



Fig 8. Photograph showing Carter Thomason device (pilot guide with suture passer).

Annexures

<h2>Annexure IV</h2>



ANNEXURE IV – MASTER CHART

LA - LAPAROSCOPIC APPENDECTOMY

LC- LAPAROSCOPIC CHOLECYSTECTOMY

LCBDE- LAPAROSCOPIC COMMON BILE DUCT EXPLORATION

LCG- LAPAROSCOPIC CYSTOGASTROSTOMY

LHR- LAPAROSCOPIC HERNIA REPAIR

DL – DIAGNOSTIC LAPAROSCOPY

LAP GJ – LAPAROSCOPIC GASTRO-JEJUNOSTOMY

LAP RECTOPEXY – LAPAROSCOPIC RECTOPEXY

GOO – GASTRIC OUTLET OBSTRUCTION

CBD CALCULI – COMMON BILE DUCT CALCULI

UH – UMBILICAL HERNIA

PUH – PARAUMBILICAL HERNIA

PAUE- PAIN ABDOMEN UNDER EVALUATION

mm – MILLIMETRE

Y – YES

N – NO

DOA – DATE OF ADMISSION

DOS – DATE OF SURGERY

DOD – DATE OF DISCHARGE

Min- MINUTES

S. No	GROUP	IP No.	AGE/SEX	DOA	DOS	DOD	DIAGNOSIS	PROCEDURE	NO.OF PORTS USED/CLOSED	TYPE OF ANAESTHESIA	CO- MORBITIES	DURATION OF PROCEL	TIME TAKEN USING CONVE	TIME TAKEN FOR UMBILIC	MEAN TIME TAKEN FO	SEROMA FORMATION	WOUND INFECTION	PORT SITE HERNIA	3MONTHS	6 months
1	A	703674	48/M	11/22/2015	11/24/2015	11/27/2015	ACUTE APPENDICITIS	LA	2	GA	NIL	42.3	8.4		4.2	N	N		N	N
2	A	703897	50/M	11/23/2015	11/26/2015	11/29/2015	ACUTE APPENDICITIS	LA	2	GA	DM	46.4	8.8		4.4	N	N		N	N
3	A	706317	41/M	12/7/2015	12/8/2015	12/11/2015	ACUTE APPENDICITIS	LA	2	GA	NIL	36.4	9.6		4.8	N	N		N	N
4	A	708616	65/F	12/12/2015	12/15/2015	12/23/2015	CALCULOUS CHOLELITHIASIS	LC	2	GA	DM,HTN	55.3	6.6		3.3	Y	Y		N	N
5	A	708963	27/F	12/20/2015	12/22/2015	12/25/2015	ACUTE APPENDICITIS	LA	2	GA	NIL	47.7	8		4	N	N		N	N
6	A	712820	44/M	1/10/2016	1/13/2016	1/20/2016	CHOLELITHIASIS	LC	2	GA	HTN	59.4	8.9		4.45	Y	N		N	N
7	A	716479	25/M	1/28/2016	2/2/2016	2/10/2016	PSUEDOCYST OF PANCREAS	LCG	3	GA	NIL	156.2	8.2		2.73	Y	N		N	N
8	A	716718	35/F	2/3/2016	2/6/2016	2/9/2016	CHOLELITHIASIS	LC	2	GA	NIL	69.3	11.2		5.6	N	N		N	N
9	A	716910	40/F	2/12/2016	2/12/2016	2/20/2016	CHOLELITHIASIS	LC	2	GA	NIL	71.5	9.4		4.7	Y	N		N	N
10	A	717732	54/M	2/13/2016	2/18/2016	6/24/2016	CBD CALCULI	LCBDE	3	A	NIL	187.6	10		3.33	N	N		N	N
11	A	720092	60/F	2/20/2016	2/23/2016	2/27/2016	CHOLELITHIASIS	LC	2	GA	NIL	67.4	8.3		4.15	N	N		N	N
12	A	720127	54/F	2/20/2016	2/24/2016	2/28/2016	CHOLELITHIASIS	LC	2	GA	DM	78.3	13.5		6.75	N	N		N	N
13	A	721760	34/F	3/5/2016	3/8/2016	3/12/2016	CALCULOUS CHOLELITHIASIS	LC	2	GA	NIL	59.3	9.5		4.75	N	N		N	N
14	A	726780	38/M	3/26/2016	3/29/2016	4/2/2016	ACUTE APPENDICITIS	LA	2	GA	NIL	36.4	8.6		4.3	N	N		N	N
15	A	727079	25/F	3/30/2016	3/31/2016	4/3/2016	ACUTE APPENDICITIS	LA	2	GA	NIL	44.7	8.8		4.4	N	N		N	N
16	A	723525	75/M	4/4/2016	4/7/2016	4/15/2016	SPIGELIAN HERNIA	LHR	2	GA	DM,IHD	136.4	10.5		5.25	N	N		N	N
17	A	731042	28/M	4/20/2016	4/24/2016	4/30/2016	PANCREATIC CALCULI	LAP PJ	3	GA	NIL	167.4	12.4		4.1	N	N		N	N
18	A	734875	71/M	5/6/2016	5/11/2016	5/20/2016	GOO	LAP GJ	3	GA	DM,HTN	147.8	11.6		3.86	N	N		N	N
19	A	697578	30/M	10/28/2015	11/3/2015	11/10/2015	PAUE	DL	2	GA	NIL	34.1	7.2		3.6	Y	N		N	N
20	A	700138	27/F	11/4/2015	11/5/2015	11/16/2015	PERFORATED APPENDIX	LA	2	GA	NIL	74.9	6.5		3.25	Y	Y		N	N
21	A	701329	70/M	11/14/2015	11/17/2015	11/21/2015	CALCULOUS CHOLELITHIASIS	LC	2	GA	IHD	87.3	8.7		4.35	N	N		N	N
22	A	702590	35/F	11/12/2015	11/19/2015	11/25/2015	PAUE	DL	2	GA	NIL	42.1	9.6		4.8	N	N		N	N
23	A	702465	26/M	11/15/2015	11/17/2015	11/25/2015	ACUTE APPENDICITIS	LA	2	GA	NIL	38.1	7		3.5	Y	N		N	N
24	A	698304	57/M	10/24/2015	10/27/2015	11/2/2015	CHOLELITHIASIS	LC	2	GA	HTN	64.3	9.7		4.85	Y	N		N	N
25	A	741980	21/F	6/10/2016	6/13/2016	6/16/2016	ACUTE APPENDICITIS	LA	2	GA	NIL	54.1	7.5		3.75	N	N		N	N
26	A	742243	53/F	6/10/2016	6/13/2016	6/16/2016	ACUTE APPENDICITIS	LA	2	GA	NIL	62.7	9.8		4.9	N	N		N	N
27	A	743748	26/M	6/18/2016	6/23/2016	6/28/2016	PSUEDOCYST OF PANCREAS	LCG	3	GA	NIL	174.8	13.6		4.53	N	N		N	N
28	A	796166	38/F	7/2/2016	7/4/2016	7/7/2016	ADHESIONS	ADHESIOL	2	GA	NIL	72.1	9		4.5	N	N		N	N
29	A	799123	45/M	7/2/2016	7/4/2016	7/7/2016	ACUTE APPENDICITIS	LA	2	GA	NIL	29.1	8.2		4.1	N	N		N	N
30	A	800141	28/F	7/11/2016	7/13/2016	7/16/2016	ACUTE APPENDICITIS	LA	2	GA	NIL	49.1	7.4		3.7	N	N		N	N
31	A	800878	18/F	7/16/2016	7/18/2016	7/21/2016	ACUTE APPENDICITIS	LA	2	GA	NIL	38.4	6.5		3.25	N	N		N	N
32	A	752293	24/F	8/1/2016	8/3/2016	8/5/2016	ACUTE APPENDICITIS	LA	2	GA	NIL	37.9	8		4	N	N		N	N
33	A	752780	31/M	8/6/2016	8/8/2016	8/12/2016	RECTAL PROLAPSE	RECTOPEX	2	GA	NIL	98.4	6.3		3.15	N	N		N	N
34	A	755862	27/M	8/20/2016	8/22/2016	8/25/2016	ACUTE APPENDICITIS	LA	2	GA	NIL	42.5	9.2		4.6	N	N		N	N
35	A	757496	24/M	8/26/2016	8/28/2016	9/5/2016	LONG. DIAPHRAGMATIC HERNIA	LHR	3	GA	NIL	227.2	14.5		4.83	Y	N		N	N
36	A	756232	53/F	8/30/2016	8/31/2016	9/4/2016	PAUE	DL	2	GA	NIL	42.1	7.5		3.75	N	N		N	N
37	A	761256	60/F	10/10/2016	10/12/2016	10/15/2016	UH	LHR	2	GA	DM,HTN	73.6	11.4		5.7	N	N		N	N

38	A	766534	46/F	10/15/2016	10/17/2016	10/20/2016	PUH	LHR	2	GA	NIL	64.8	13.6		6.8	N	N		N	N
39	A	766567	35/F	10/15/2016	10/19/2016	10/27/2016	PSUEDOCYST OF PANCREAS	LCG	3	GA	NIL	194.5	14.6		4.86	Y	Y		N	N
40	A	761432	39/F	10/22/2016	6/24/2016	10/27/2016	PUH	LHR	2	GA	NIL	87.3	8.5		4.25	N	N		N	N
41	A	767722	15/F	10/22/2016	10/24/2016	10/27/2016	ACUTE APPENDICITIS	LA	2	GA	NIL	46.2	6.8		3.4	N	N		N	N
42	A	764335	43/F	10/24/2016	10/26/2016	10/29/2016	HEMORRHAGIC OVARIAN CYST	RIAN CYST	2	GA	NIL	59.5	9.3		4.65	N	N		N	N
43	A	768394	46/M	11/5/2016	11/7/2016	11/14/2016	LIVER ABSCESS	SCESS DR	3	GA	NIL	149.4	13.7		4.56	Y	Y		N	N
44	A	770336	35/F	11/7/2016	11/9/2016	11/13/2016	PUH	LHR	2	GA	NIL	97.5	10.7		5.35	N	N		N	N
45	A	746146	46/F	11/20/2016	11/22/2016	11/26/2016	PAUE	DL	2	GA	NIL	59.4	9		4.5	N	N		N	N
46	A	773633	42/F	11/20/2016	11/22/2016	11/28/2016	PAUE	DL	2	GA	NIL	47.4	11.6		5.8	Y	Y		N	N
47	A	774544	16/F	11/20/2016	11/22/2016	11/25/2016	ACUTE APPENDICITIS	LA	2	GA	NIL	35.1	6.3		3.1	N	N		N	N
48	A	743213	60/F	11/28/2016	11/30/2016	12/2/2016	CHOLELITHIASIS	LC	2	GA	DM	118.5	11.8		5.9	N	N		N	N
49	A	774277	40/F	12/5/2016	12/7/2016	12/14/2016	CHOLELITHIASIS	LC	2	GA	NIL	104.6	12.7		6.3	Y	N		N	N
50	A	776235	23/F	12/10/2016	12/12/2016	12/15/2016	ACUTE APPENDICITIS	LA	2	GA	NIL	38.5	10		5	N	N		N	N
51	B	697260	30/M	10/18/2015	10/20/2015	10/23/2015	ACUTE APPENDICITIS	LA	2	GA	NIL	37.3		3.4	1.7	N	N		N	N
52	B	698308	52/F	10/23/2015	10/27/2015	11/2/2015	CHOLELITHIASIS	LC	2	GA	DM	87.4		4	2	N	N		N	N
53	B	706498	35/M	12/7/2015	12/8/2015	12/13/2015	ACUTE APPENDICITIS	LA	2	GA	NIL	38.3		4	2	Y	N		N	N
54	B	703262	39/M	12/11/2015	12/11/2015	12/21/2015	PERFORATED APPENDIX	LA	2	GA	NIL	132.7		3.5	1.75	Y	Y		N	N
55	B	707902	40/F	12/11/2015	12/15/2015	12/24/2015	ACHLASIA CARDIA	JNDOPLIC	3	GA	NIL	217.6		3	1	N	N		N	N
56	B	713994	19/M	1/17/2016	1/18/2016	1/21/2016	ACUTE APPENDICITIS	LA	2	GA	NIL	43.6		4	2	N	N		N	N
57	B	715466	28/M	1/25/2016	1/28/2016	2/6/2016	PSUEDOCYST OF PANCREAS	DL	3	GA	NIL	64.7		3.3	1.1	N	N		N	N
58	B	716479	60/M	1/30/2016	2/2/2016	2/15/2016	LIVER ABSCESS	SCESS DR	3	GA	NIL	135.7		4.7	1.56	N	N		N	N
59	B	716408	49/F	1/27/2016	2/4/2016	2/8/2016	CHOLELITHIASIS	LC	2	GA	NIL	99.6		3	1.5	N	N		N	N
60	B	717718	40/F	2/1/2016	2/4/2016	2/8/2016	CHOLELITHIASIS	LC	2	GA	NIL	86.7		3.5	1.75	N	N		N	N
61	B	716910	43/F	2/13/2016	2/18/2016	2/26/2016	CBD CALCULI	LCBDE	3	GA	NIL	205.6		4	1.33	N	N		N	N
62	B	718622	31/M	2/19/2016	2/23/2016	2/27/2016	CHOLELITHIASIS	LC	2	GA	NIL	85.6		3.5	1.75	Y	N		N	N
63	B	720202	42/M	2/18/2016	2/24/2016	3/2/2016	SPLEENIC ABSCESS	SCESS DR	2	GA	DM	139.5		3.5	1.75	Y	N		N	N
64	B	721109	60/M	2/25/2016	3/1/2016	3/7/2016	GOO	LAP GJ	2	GA	DM	163.5		4	2	N	N		N	N
65	B	721805	36/M	2/27/2016	3/1/2016	3/4/2016	ACUTE APPENDICITIS	LA	2	GA	NIL	35.2		3.5	1.75	N	N		N	N
66	B	723891	30/F	3/14/2016	3/17/2016	3/21/2016	CHOLELITHIASIS	LC	2	GA	NIL	78.4		6	3	N	N		N	N
67	B	728191	45/M	3/4/2016	3/5/2016	3/8/2016	ACUTE APPENDICITIS	LA	2	GA	NIL	54.2		2.5	1.25	N	N		N	N
68	B	725451	58/M	4/16/2016	4/19/2016	4/25/2016	HYDATID CYST OF LIVER	SCESS DR	3	GA	NIL	186.3		5.9	1.96	N	N		N	N
69	B	726134	15/M	5/10/2016	5/11/2016	5/14/2016	UH	LHR	2	GA	NIL	134.6		5	2.5	N	N		N	N
70	B	737153	25/M	5/18/2016	5/19/2016	5/23/2016	ACUTE APPENDICITIS	LA	2	GA	NIL	47.2		3.5	1.75	N	N		N	N
71	B	738991	32/M	5/25/2016	5/28/2016	6/3/2016	CALCULOUS CHOLELITHIASIS	LC	2	GA	NIL	58.3		4.5	2.25	N	N		N	N
72	B	739007	45/F	5/25/2016	5/30/2016	6/4/2016	CHOLELITHIASIS	LC	2	GA	NIL	75.5		4.5	2.25	N	N		N	N
73	B	739959	46/F	5/30/2016	6/2/2016	6/6/2016	CHOLELITHIASIS	LC	2	GA	NIL	48.5		6	3	N	N		N	N
74	B	739425	67/M	5/28/2016	6/2/2016	6/10/2016	EMPHYEMA GB	LC	2	GA	DM,HTN	137.5		5	2.5	N	N		N	N
75	B	740881	60/F	6/5/2016	6/7/2016	6/12/2016	CALCULOUS CHOLELITHIASIS	LC	2	GA	HTN	67.4		4.8	2.4	N	N		N	N
76	B	742243	50/F	6/10/2016	6/13/2016	6/16/2016	PUH	LHR	2	GA	DM	127.5		3.5	1.75	N	N		N	N
77	B	740247	60/F	6/7/2016	6/9/2016	6/14/2016	RECTAL PROLAPSE	RECTOPEX	2	GA	DM,HTN	135.7		4	2	N	N		N	N
78	B	743859	50/F	6/20/2016	6/22/2016	6/25/2016	CHOLELITHIASIS	LC	2	GA	NIL	87.9		6	3	N	N		N	N
79	B	743944	35/M	6/25/2016	6/27/2016	6/30/2016	ACUTE APPENDICITIS	LA	2	GA	NIL	53.6		5.5	2.75	N	N		N	N
80	B	744862	56/M	6/28/2016	6/29/2016	7/7/2017	DIAPHRAGMATIC EVENTRATIO	LHR	3	GA	DM	264.7		3.5	1.16	N	Y		N	N
81	B	787898	38/F	7/2/2016	7/4/2016	7/10/2016	PAUE	DL	2	GA	NIL	57.8		3	1.5	N	N		N	N
82	B	792327	32/M	7/11/2016	7/13/2016	7/16/2016	ACUTE APPENDICITIS	LA	2	GA	NIL	47.6		4.5	2.25	N	N		N	N
83	B	752036	27/M	8/2/2016	8/3/2016	8/6/2016	ACUTE APPENDICITIS	LA	2	GA	NIL	64.7		5.5	2.75	N	N		N	N

84	B	752270	16/F	8/1/2016	8/3/2016	8/6/2016	ACUTE APPENDICITIS	LA	2	GA	NIL	57.9		5	2.5	N	N		N	N
85	B	754952	26/M	8/6/2016	8/8/2017	8/11/2016	ACUTE APPENDICITIS	LA	2	GA	NIL	63.6		4.6	2.3	N	N		N	N
86	B	756742	11/F	8/6/2016	8/9/2016	8/17/2016	PSUEDOCYST OF PANCREAS	LCG	3	GA	NIL	278.5		4.5	1.5	N	N		N	N
87	B	755953	53/F	8/21/2016	8/22/2016	8/27/2016	PERFORATED APPENDIX	LA	2	GA	NIL	95.6		4	2	N	N		N	N
88	B	757137	65/F	8/28/2016	8/31/2016	9/5/2016	CHOLELITHIASIS	LC	2	GA	NIL	90.4		3.5	2.75	N	N		N	N
89	B	758760	26/M	9/9/2016	9/12/2016	9/20/2016	PSUEDOCYST OF PANCREAS	LCG	3	GA	NIL	247.8		6	2	N	N		N	N
90	B	764712	35/M	10/1/2016	10/3/2016	10/7/2016	RECTAL PROLAPSE	RECTOPEX	2	GA	NIL	160.7		4.5	2.25	Y	N		N	N
91	B	765565	35/M	10/5/2016	10/12/2016	10/20/2016	Ca STOMACH	DL	2	GA	NIL	34.6		3.5	1.75	N	N		N	N
92	B	763977	62/M	10/10/2016	10/12/2016	10/16/2016	CALCULOUS CHOLELITHIASIS	LC	2	GA	DM,HTN	78.9		5	2.5	N	N		N	N
93	B	766840	47/F	10/14/2016	10/17/2016	10/20/2016	ACUTE APPENDICITIS	LA	2	GA	NIL	37.4		4.8	2.4	N	N		N	N
94	B	767381	60/F	10/16/2016	10/19/2016	10/22/2016	CALCULOUS CHOLELITHIASIS	LC	2	GA	IHD	98.6		5	2.5	N	N		N	N
95	B	768244	35/F	10/22/2016	10/24/2016	10/27/2016	ACUTE APPENDICITIS	LA	2	GA	NIL	39.5		4.3	2.15	N	N		N	N
96	B	769823	40/M	10/30/2016	11/2/2016	11/5/2016	CHRONIC APPENDICITIS	LA	2	GA	HTN	46.5		2.8	1.4	N	N		N	N
97	B	770210	45/F	11/1/2016	11/2/2016	11/8/2016	PERFORATED APPENDIX	LA	2	GA	NIL	87.6		4	2	Y	Y		N	N
98	B	770645	28/M	11/6/2016	11/9/2016	11/13/2016	UH	LHR	2	GA	NIL	147.5		3.5	1.75	N	N		N	N
99	B	771325	19/F	11/21/2016	11/22/2016	11/25/2016	ACUTE APPENDICITIS	LA	2	GA	NIL	64.5		6.5	3.25	N	N		N	N
100	B	775580	50/F	4-Dec	12/7/2016	12/12/2016	RECTAL PROLAPSE	RECTOPEX	2	GA	DM	143.8		4	2	N	N		N	N