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Single Incision Laparoscopic Surgery with Conventional Instruments

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INTRODUCTION

Increasing public demand for less and less invasive surgery have seen the gradual shift from many access incisions to single incision and NOTES. Several reports of laparoscopic surgery being performed through a single incision have come up over the recent years. Several case reports and articles have been published describing appendectomy, cholecystectomy, nephrectomy, pyeloplasty, colectomy and sleeve gastrectomy being performed through a single incision umbilical access [1-7]). This shift however has been gradual. Needlescopic surgery where the size of the ports were reduced from 5mm to 2mm and consequent miniaturization of the instrument was reported was the first step in the direction [8]. Single Incision Laparoscopic Surgery (SILS) has seen rapid progress from innovative ports and instruments to operative techniques have been [9]. These new instruments however are expensive and beyond the reach of many surgeons in the developing world. Thus our aim was to study the feasibility of performiing SILS using conventional ports and instruments.

METHODS.

Patients undergoing laparoscopic surgery at our center were selected for participation in this study after obtaining a written informed consent. All procedures were performed using conventional laparoscopic instruments. Operative data including operative time(from time of incision to port closure), blood loss, additional ports used, energy sources used, intraoperative complications, margins and lymph nodes harvested(where applicable)were recorded. Postoperative length of stay in hospital was recorded. The patients were followed up at one week after the surgery and at three months.

SURGICAL TECHNIQUE

General anesthesia was used in all patients and epidural analgesia was added in pelvic surgery.

The Incision

A standard 2 cm peri-umbilical skin incision was used in all patients, the incision being supra-umbilical for cholecystectomies and infra-umbilical for surgeries in the pelvis.

Pneumoperitoneum

In the initial few procedures the open technique was used to insert the 10 mm trocar into the superior or inferior umbilical tube as per the procedure. In the subsequent procedures Veress needle was used through the same incision, followed by trocar entry.

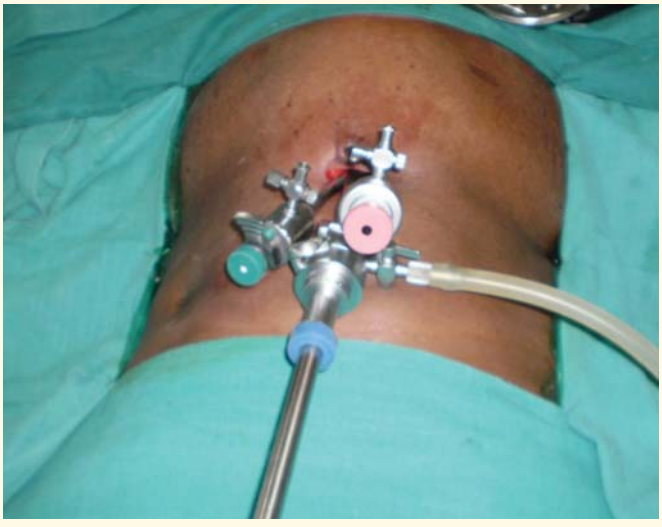

Fig. 1: **Port postion – external wiew**

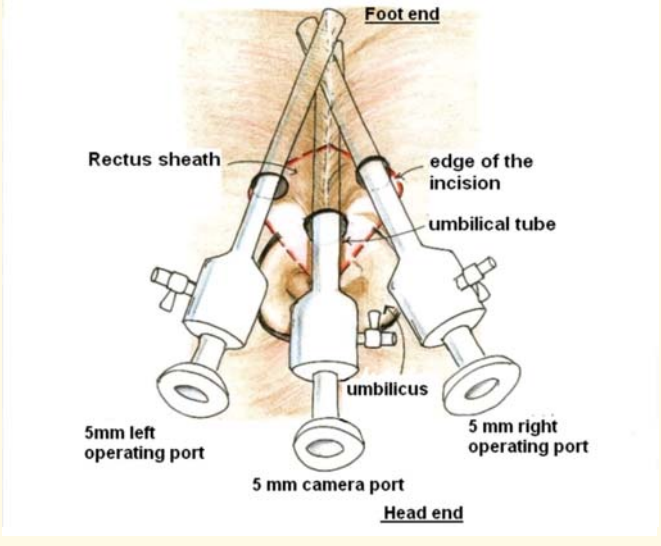

Fig. 2: **Schematic representation of port position for SILS Hysterectomy**

Ports and instruments

A total three ports were used which were inserted transperitoneally through the periumbilical skin incision (Fig. 1). Entry was through the open umbilical tube technique. Multi-fascial punctures were made as shown in (Fig.2).Triangulation approaching that of conventional surgery was achieved by positioning two 5 mm ports 1 to 2 cm ahead of the10mm port and oriented in 10 and 2 o'clock positions respectively. Zero degree telescope and standard laparoscopic

Fig 3: **The 2 cm incision that remains prior to skin closure**

"straight" working instruments were used to complete all procedures. Energy sources used for dissection included the Harmonic Ace (Ethicon Endosurgery, Cincinnati, Ohio), vessel sealing (Bowa Electric, Gomaringen, Germany), monopolar and the bipolar electro-cautery devices (Valley Lab,Tyco Healthcare, Boulder,CO,USA). Standard 5mm clip applicators were used for ligation of the cystic duct and hemoclips were used for vascular control when necessary. In some cases when a 10mm clip applicator was required, a 5 mm telescope was used interchangeably. High definition optics (Maxer HD, Germany) were used.

Incision closure

The 10 mm trocar fascial incision was closed with delayed absorbable polyglactin Vicryl 2-0 sutures (Ethicon, Johnson&Johnson, Aurangabad, India). The 2 cm scar that remained is shown in Fig.3. Skin was approximated with subcuticular Monocryl 3-0(Ethicon, Johnson&Johnson, Aurangabad, India) sutures.

RESULTS

Twenty two procedures were performed during the study period (Table 1).24.6,26.8, and 21.6 for chole-

Procedure	No.	Mean Age	Mean BMI	Average Blood loss(ml)	Mean Operative time(mins)	Average Length of stay(days)	Conversion
Cholecystectomy	5	41.8(28-52)	30.8(20.4-36.4)	25(15-35)	54.2(40-68)	2(1-4)	–
Oophorectomy	3	33.3(26-42)	24.6(19.6-26)	25(25-50)	28.7(16-38)	1(1)	–
Hysterectomy	11	41.9(28-58)	26.8(18.1-30.0)	20(10-35)	88 (60-128)	1(1-3)	–
Radical Hysterectomy	2	40(34-46)	21.6(23.4-19.8)	60(50-70)	190(186-300)	3	–

cystectomy, oophorectomy, hysterectomy and radical hysterectomy respectively. All procedures were completed to totally through the single incision. There were no conversions to conventional laparoscopic or open surgery. Data for the various procedures performed show that operative time, blood loss and hospital stay are comparable with those of conventional laparoscopy. The mean BMI of patients were 30.8.

CHOLECYSTECTOMY

The incision was placed in the supra-umbilical region centering over the umbilical tube. Three conventional laparoscopic ports were used as described earlier. A conventional grasper and the harmonic shears were used to for dissection. Starting the procedure with the 'traditional' dissection of the Calot's triangle proved to be difficult due limited working space and difficulty in retraction. We adopted the "fundus first technique" in all subsequent patients which enabled better retraction of the gallbladder without the need for extra-corporeal retraction. The cystic duct was clipped with metal clips which required the interchanging of the 10mm telescope with the clip applicator, vision being provided with a 5mm telescope through one of the working ports. Specimen extraction was through the use of bags through the primary access port which at times required dilatation.

HYSTERECTOMY

The skin incision was placed in the infra-umbilical region with the two working trocars ahead of the camera trocar toward the pelvis. Crossing of instruments and uterine manipulation greatly improved ergonomics. Standard steps as described by the author could be executed to complete the procedure. The uterine vessels were taken down with harmonic shears or metal clips as necessary. The specimen was placed in a bag and removed transvaginally. The colpotomy was closed using polyglactin sutures intracorporeally. We had found the colpotomizer, a very useful instrument to delineate the level of colpotomy, despite the fact that we do not use it in conventional multiport surgery.

OOPHORECTOMY

Two patients underwent ovariectomy for benign cysts of the ovary. One patient underwent bilateral oophorectomy for ovarian cancer risk reduction. The ovarian pedicles and cysts were dissected with the harmonic shears and large vessels were clipped with hemoclips when necessary.

RADICAL HYSTERECTOMY

The "Pune technique" of Laparoscopic radical hysterectomy has been described [12]. Two patients with FIGO stage IB and CT scan showing no pelvic lymphadenopathy were selected for the procedure. Keeping with oncologic principles no uterine manipulators were used. The standard steps included identifying the ureters on both sides with their medialization, the posterior 'U' cut and dissection in the pouch of Douglas, dissection of para-rectal spaces, clipping the uterine

arteries, anterior peritoneal U cut with bladder dissection and a colpotomy with a 3.5 cm vaginal cuff on the specimen side. The fatty and lymphatic tissue along the external iliac vessels and the obturator nerve on both sides was dissected. Sword-fighting of instruments enabled dissection. The specimen and the nodal tissue was placed in a endobag and extracted through the colpotomy. The excised specimen was examined for tumor margins, parametrium clearance, number of lymph nodes and length of the vaginal cuff as applicable.

DISCUSSION

Conventional single incision surgery has been used for almost three decades now, in the form of laparoscpic tubal ligation for fertility control. The first Single incision surgery for removal of the gallbladder was published in 1997 by Navarra and colleagues. [14] Since then there has been an explosion of reports and instruments through which even complex surgeries could be performed through a single incision. Several names exist like LESS, SILS, NOTUS, etc but essentially the concept remains the same, surgery that is performed in entirety through a single incision.

We started with laparoscopic gynecologic procedures and then moved ahead with cholecystectomy with increasing experience. As our expertise increased with SIL hysterectomies we attempted and successfully completed two SIL radical hysterectomies using the authors' Pune technique. Patients were carefully selected only after laparoscopic vision confirmed anatomic feasibility for the procedure to continue, in the form of absent adhesions, non bulky uterus, frozen pelvis, etc. Total laparoscopic hysterectomy could be performed with the use of the bipolar and ultrasonic instruments. The addition of the harmonic (Harmonic Ace 5 mm, Ethicon Endosurgery, Cincinnati, USA) made dissection quicker and less frequent instrument changes were required further improving operative times. The internal view of instruments crossing over in sword-fighting is shown in the figure. The most difficult part of the procedure was the intracorporeal suturing due to lack of triangulation. Nevertheless we could complete successful vaginal closure in all patients. Mean operative time was 88 minutes for hysterectomy which included intracorporeal suturing times, a time comparable to conventional laparoscopic hysterectomy.

In the two patients with Stage Ib2 carcinoma cervix who underwent radical hysterectomy, we were able to successfully apply the same principles of single incision surgery combined with the Pune technique. We had achieved lymph node and parametrial clearance comparable to our existing series. [17] A colpotomizer was used to delineate the cervico vaginal interface. An additional 5mm trocar was required in the first patient through the same incision top complete the ureteric tunnel dissection on the right side. Both patients were discharged on the third postoperative day with one patient requiring a Foley's catheter at discharge owing to urinary retention which was removed after 10 days. Both patients had non bulky disease and a small uterine size whichcould be manipulated with one instrument for traction.

	Stage	Vaginal margin	Lymph nodes	Parametrium	Operative time
Patient 1	Stage Ib2	3 cm	14	3.5 cm	300 mins
Patient 2	Stage Ib2	3.5 cm	16	3 cm	186 mins

Removal of the gall bladder by the use of less invasive ports is not new. SIL cholecystectomy was performed as early as 1997. [14] Several ports and techniques have been described. [9] The use of extracorporeal slings to delineate the Calot's triangle is also described by others [10]. We performed all the cholecystectomies with the 'fundus first' technique. This was a safe adaptation as the gallbladder could be used as a retracting aid to spread out the Calot's. We found it a safe adaptation for dissection of the gallbladder, enabling visualization of the critical angle of safety avoiding use of slings. 'Cold dissection' was performed

at the Calot's triangle and energy sources used only in fundus and gallbladder-liver interface.

Fig.4: **Internal view of Sword-fighting**

Three problems mainly arise in SILS. First, instrument crowding. This was overcome by crossing instruments in the operative field akin to fighting with a sword. This maneuver uses the increased space and ergonomics afforded by working inversely with instruments, the left hand dissecting on the right and the right hand working on the left. (Fig 4) Second, the problem of gas leakage. This was most commonly at the middle 10mm port. This was overcome by changing to Veress needle entry followed by port insertion in our subsequent cases. The 5 mm trocars rarely caused problems as their entry was in a different fascial plane. The insertion of the 5 mm working trocars is essentially blind, though safe as they are inserted at a level higher than the camera port in a direction just parallel to the anterior abdominal wall. The third problem is due t o poor vision as the camera surgeon is left with very little space. We operate with high definition optics which greatly enhance vision and enable fine dissection. We also are of the opinion that the surgery is better performed in patients with a healthier BMI, as patients with a lower BMI compounded crowding increasing operative time.

Recent advances in the field of single port surgery have been in access ports, the SILS Port Multiple Instrument Access Port(Covidien, Mansfield, Massaceusetts), GelPort (Applied Medical Systems, Boston, MA), ASC R-Port laparoscopic Access Device (Advanced Surgical Concepts, Wicklow, Ireland). [9][15]. These ports are disposable and have not reached the developing world market until recently. The cost-effectiveness of these ports in our patients are to be seen, as we are able to perform reasonably well without them.

The surgery however performed is satisfactory only when vision is flawless, assistance is apt, surgeon is experienced and patient is accomodating. All departments must work in harmony to complete the surgery. Inexperience on the part of the surgeon, his assistant, camera surgeon, and defective instrumentation could force the team to convert. We have not converted a single procedure to either conventional or open. This is obviously due to the bias in selection, which is also the way of performing such surgery in the future. We had no wound complications in our 22 patients and no hernias or delayed pain at three month followup. Since this was feasibility study we did not measure pain and quality of life, but patients definitely seemed optimistic about their scar and surgery.

With laparoscopic surgery being adapted to perform almost any operation within visceral cavities with surgical outcome comparable and sometimes better than open procedures, SILS may take over the role of conventional multiport laparoscopy in performing simple procedures like cholecystectomies, nephrectomies, etc.

Reproducibility is the big question as SILS is technically demanding. Most of the above difficulties may be obviated by the use of robotics. The concept of a fixed surgeon controlled camera, the seven degrees of freedom of the operating robotic arms and the unparalleled three dimensional vision, make robotic application in SILS the next step forward. Reports of successful application of robotics to SILS have emerged and seem promising [13]. Tackling advanced laparoscopic procedures with robotic aid coupled with single incision is what the future probably holds.

Whether SILS passes from the hands of advanced laparoscpic surgeon to mainstream practice, only time will tell. And if costs of such instruments is an impediment for resource constrained countries like ours, we have shown a feasible way of moving forward in the scarless direction.

CONCLUSION

This is the first report of SILS including gynecological oncological surgeries. Whether laparoscopic surgery through a single incision would threaten the position of the current gold standard 'Conventional' laparoscopic procedures is debatable. Innovation in instrumentation, growing demand from the health care industry has forced the surgeon to develop skills to sustain such an approach. We have shown that SILS using conventional instruments is feasible and safe. The question of reproducibility remains as the skill level required is extremely high. Improvising robotics could be the future of SILS. The entry of robotic surgery into surgical practice might define the future of SILS bridging the learning curve required to master the procedure otherwise.

REFERENCES

1. Desai MM, Rao PP, Aron M, et al. Scarless single port transumbilical nephrectomy and pyeloplasty: first clinical report. BJU Int 2008;101:83-88.
2. Canes D, Desai MM, Aron M, et al. Transumbilical singleport surgery: evolution and current status. Eur Urol 2008;54:1020–1029.
3. Barbaros U, Dinçça A. Single incision laparoscopic splenectomy: the first two cases. J Gastrointest Surg. 2009 Aug;13(8):1520-3. Epub 2009 Apr 14.
4. Gumbs AA, Milone L, Sinha P, et al. Totally transumbilical laparoscopic cholecystectomy. J Gastrointest Surg 2009,13:533–534.
5. Messina M, Garzi A, Molinaro F, et al. [Video-assisted transumbilical appendectomy: an effective and safe alternative in noncomplicated appendicitis].Minerva Chir 2005;60:129–130.
6. Remzi FH, Kirat HT, Kaouk JH, Geisler DP. Single-port laparoscopy in colorectal surgery. Colorectal Dis. 2008 Oct;10(8):823-6. Epub 2008 Aug 5.
7. Saber AA, Elgamal MH, Itawi EA, Rao AJ. Single incision laparoscopic sleeve gastrectomy (SILS): a novel technique. Obes Surg. 2008 Oct;18(10):1338-42. Epub 2008 Aug 8.
8. Reardon PR, Kamelgard JI, Applebaum B, Rossman L, Brunicardi FC. Feasibility of laparoscopic cholecystectomy with miniaturized instrumentation in 50 consecutive cases. World J Surg. 1999 Feb;23(2):128-3.
9. Ponsky TA. Single Port Laparoscopic Cholecystectomyin Adults and Children: Tools and Techniques. J Am Coll Surg. 2009 Nov;209(5):e1-6. Epub 2009 Sep 3.
10. Marescaux J, Dallemagne B, Perretta S, Wattiez A, Mutter D, Coumaros D. Surgery without scars: report of transluminal cholecystectomy in a human being. Arch Surg. 2007 Sep;142(9):823-6; discussion 826-7.
11. Philipp SR, Miedema BW, Thaler K. Single-Incision Laparoscopic Cholecystectomy Using Conventional Instruments: Early Experience in Comparison with the Gold Standard. J Am Coll Surg. 2009; 209(5):632-7.
12. Puntambekar SP, Palep RJ, Puntambekar SS, Wagh GN, Patil AM, Rayate NV, Agarwal GA. Laparoscopic total radical hysterectomy by the Pune technique: our experience of 248 cases. J Minim Invasive Gynecol. 2007 Nov-Dec;14(6):682-9.
13. Escobar PF, Fader NA, Paraiso MF, Kaouk JH, Falcone T. Robotic-Assisted Laparoendoscopic Single-Site Surgery in Gynecology: Initial Report amd Tecnique. J Minim Invasive Gynecol. 2009;16(5):589-91.
14. Navarra G, Pozza E, Occhionorelli S, et al. One-wound laparoscopic cholecystectomy. Br J Surg 1997;84:695.
15. Rane A, Rao P, Bonadio F, Rao P. Single port laparoscopic nephrectomy using a novel laparoscopic port (R-port) and evolution of single laparoscopic port procedure (SLIPP). J Endourol 2007;21:A287.

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