

# Comparison of Advantages and Disadvantages between SILS and NOTES

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## ABSTRACT

Minimal access surgery is the gold standard for several abdominopelvic procedures in the present era. The prime advantage with minimal access surgery is the minimal surgical trauma in comparison to the conventional surgery. The other advantages of laparoscopy like less operative time, less pain, early recovery and return to work and above all better cosmetics have been well proven. "Change is constant in life," SILS and NOTES are the two newly emerging novel techniques in laparoscopy. SILS is a new advancement in laparoscopy, where the whole surgery is conducted through a single umbilical incision whereas NOTES is totally incisionless. In real sense, the incision in NOTES is not externally visible because of the natural orifices like oral cavity, vagina, urethra and anus that are used as entry sites. SILS have the advantages of better cosmetics, less blood loss, faster recovery, less complications, early return to work, versatility, better patient acceptance and easy tissue retrieval, etc. The critics are high cost, need of high expertise and more chances of port site hernia and infection. Similarly, NOTES has its edges over traditional laparoscopy surgery with the advantages of highest cosmetic value (no visible scar), less pain, requirement of less immunosuppressant and less anesthesia, faster recovery, and no external wound complications (hernia, hematoma and abscess). But it has also its own critics like questionable safety, unproven data about complications, requirement of high expertise, low patient acceptance, requirement of advanced endoscopic instruments, difficulty in closing internal wounds, intraperitoneal infection, gastrointestinal fistula and high cost. Poor acceptance is a major concern for NOTES.

*Aims:* To explore the positive and negative aspects of above two procedures in order to find out the better option.

**Keywords:** SILS-single incision laparoscopic surgery, Natural orifice transluminal endoscopic surgery (NOTES).

## SINGLE INCISION LAPAROSCOPIC SURGERY (SILS)

SILS is an innovative advancement in the field of minimal access surgery in which the surgeon operates exclusively through a single entry point, typically the umbilicus. It was performed in 2005 for acute appendicitis in department of pediatric surgery in Turkey. Since then, it has been appreciated and accepted all over the world and every laparoscopic surgeon today feels incomplete without a proper knowledge and understanding of SILS. There are different names for SILS like SPA—single port access, LESS—laparoendoscopic single site surgery, OPUS—one port umbilical surgery, SPICES—single port incision less conventional equipment using surgery, NOTUS—natural orifice transumbilical surgery, E-NOTES—embryonic natural orifice transumbilical surgery. SILS can be performed by many methods like:

- i. With multiple facial punctures through single skin incision.
- ii. By using additional transabdominal sutures for stabilization of target organ.
- iii. By using novel port access devices.

### Access Ports (Figs 1 and 2)

- a. SILS port from Covedien
- b. GelPort system from applied medical

- c. ASC R-port, Ireland
- d. Unix-X from Pnavel concepts.

### Hand Instruments (Fig. 3)

- a. Standard conventional laparoscopic hand instruments
- b. Articulating hand instruments:
  - i. Cambridge endomaneuvres autonomy laparoangle articulating instruments.
  - ii. Novare surgical manufactures real hand instruments with angle locking.

A wide range of operations are now possible by SILS like appendectomy, cholecystectomy (Figs 4A to C), nephrectomy, hysterectomy, esophagoectomy, adrenalectomy, gastric bypass, fundoplication, hernia repair, splenectomy, colectomy, hepatic resection, cryoablation, tubal ligation, etc.

### Advantages of SILS

- a. Better cosmetics
- b. Less blood loss
- c. Faster recovery
- d. Less complications
- e. Early return to work
- f. Versatility
- g. Better patient acceptance
- h. Easy tissue retrieval.



Fig. 1: Different type of ports for single incision laparoscopic surgery



Fig. 2: Triport

### Disadvantages

- a. High cost (both trocars and hand instruments)
- b. Need of high expertise
- c. More chances of port site hernia and infection
- d. Longer operative time
- e. Technically difficult
- f. Mandatory port closure.

### NOTES

Like SILS, NOTES is also a recent innovative advancement in laparoscopic surgery in which incisionless laparoscopic procedure is possible with an endoscope equipped with hand instruments passed through a natural orifice (oral cavity, urethra, vagina and anus) than through an internal incision in the stomach, vagina (Fig. 5), urinary bladder or colon. Besides the isolated transgastric (Fig. 6), transvaginal,

transcolonic route, a combined transgastric and transvaginal approach for cholecystectomy has been performed in Portugal. NOTES was originally described in animals by Dr Anthoni Killoo from John Hopkin university. It was used for appendectomy in humans in India by Rao and Reddy and for cholecystectomy by Swanstorm in 2007. There are different ways to perform the operation like:

1. A single access multiport device with curved instruments.
2. Flexible operating endoscope with endoscopic tools.
3. Hybrid laparoscopy: Access with flexible endoscopic instruments with simultaneous abdominal access.
4. Combined multiple natural orifice access (transgastric + transvaginal).

The major advantage of NOTES is the highest cosmetic value because there is no externally visible scar after this procedure. There is less requirement of anesthesia and immunosuppressant besides less postoperative pain, faster recovery, early return to work and no abdominal wound complications like seroma, hematoma and abscess. Similarly, NOTES is not free from its own critics. For performing NOTES, highly sophisticated and expensive endoscopic as well as hand instruments (Fig. 7), a team of highly skilled and experienced surgeon and gynecologist are required. Another negative aspect is the unclear data regarding its safety, clinical outcome and postoperative complications.

### REVIEW OF SILS AND NOTES

There exists a number of techniques for performing SILS and NOTES. These can be adopted for different intra-abdominal and pelvic operations like appendectomy,<sup>2,4-6</sup> gastrostomy,<sup>7,8</sup> gastrectomy,<sup>9,10</sup> adrenalectomy,<sup>11</sup> colorectal procedures,<sup>12-15</sup> bariatric procedures<sup>9</sup> and urological

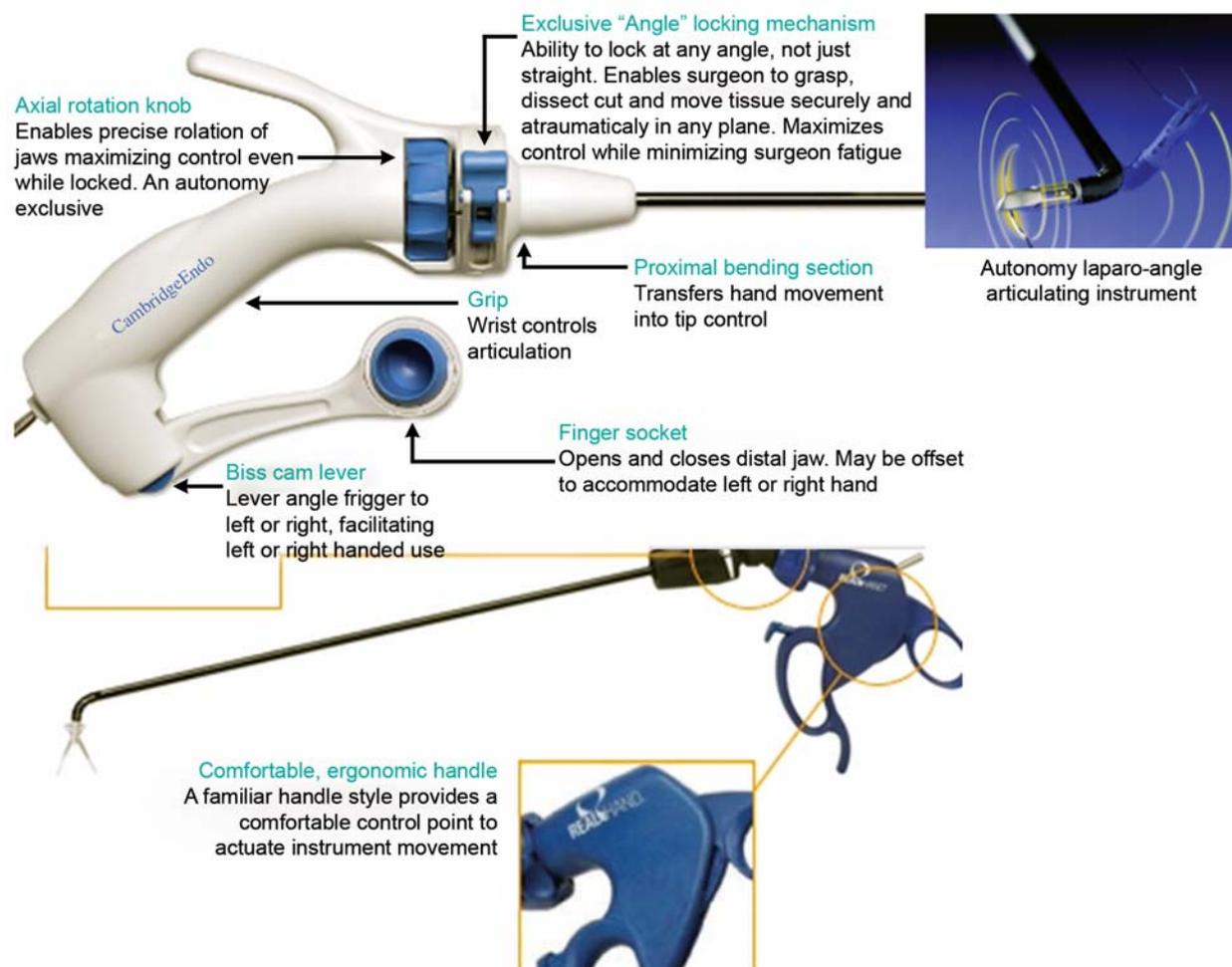
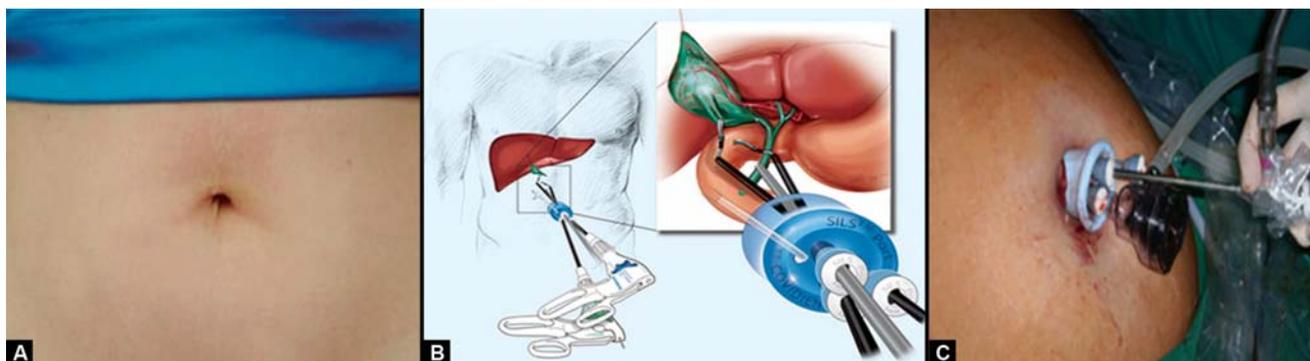


Fig. 3: Real hand instruments with angle locking



Figs 4A to C: SILS cholecystectomy

procedures.<sup>16,17</sup> But cholecystectomy is the most common procedure conducted through SILS and NOTES (Table 1).

### TECHNIQUE OF SILS CHOLECYSTECTOMY

First cholecystectomy by SILS was performed by Navara et al in 1997. He used two 10 mm trocars and three trans-abdominal stay sutures for the procedure.<sup>3</sup> Two years later in 1999, Piskun and Rajpal conducted the same procedure by using two 5 mm trocars and two stay sutures. In the above two procedures, both two umbilical trocars for telescope and hand instruments are used. Cuesta et al used

Kirschner's wire instead of stay sutures for retraction of Calot's triangle.<sup>19</sup> Average time taken for this surgery was 70 minutes.

Rao et al have conducted 20 SILS cholecystectomy using R-port, which consists of double layer plastic cylinder that serves as single port. It is introduced through 15 to 20 mm umbilical incision. The device has three valvular openings, which permit three 5 mm or one 10 mm and one 5 mm working instruments with angulated shafts. Surgery was performed successfully in 85% of cases with an average time of 30 minutes. TriPort is a similar device that has been

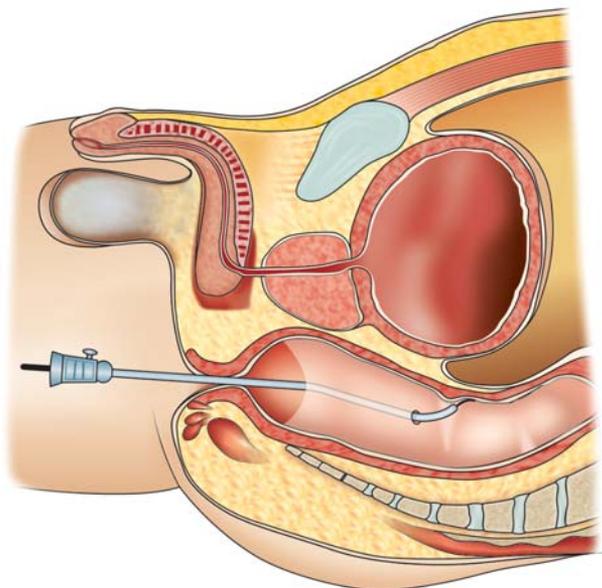


Fig. 5: Transvaginal NOTES

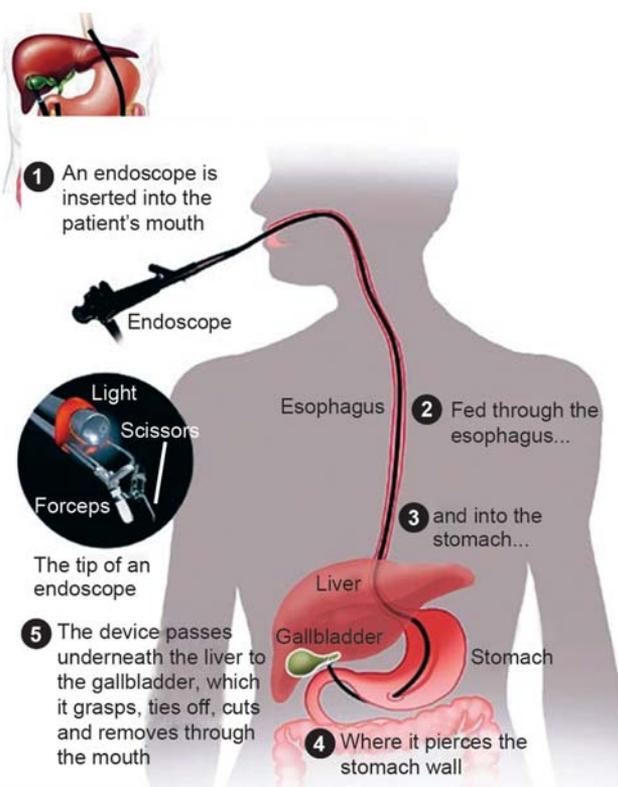


Fig. 6: Gallbladder removal through the mouth

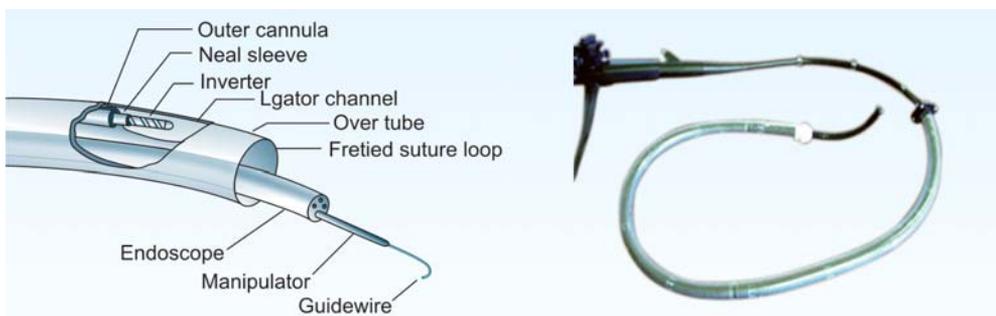


Fig. 7: NOTES instrument

used by Romanelle for SILS.<sup>20</sup> Merchant et al have used GelPort multichannel system, which allows four working instruments including the telescope.<sup>9</sup>

**TECHNIQUE OF NOTES CHOLECYSTECTOMY**

Transvaginal laparoscopically-assisted cholecystectomy using a single 5 mm and two 3 mm trocars through the anterior abdominal wall has been described by Bessler. A 5 mm trocar was used for clip applicator and 3 mm trocars were used for gallbladder retraction and pneumoperitonium. A double channel flexible endoscope, which accommodates a grasper and hook knife was introduced transvaginally. The procedure took three and half hours. Marescaux et al used a similar technique with a 2 mm transumbilical needle for pneumoperitonium and laparoscopic-guided colpotomy.<sup>1</sup> Rest of the procedure was performed transvaginally over three hours.

A different technique by Zorning in which the umbilical scope was replaced by a dissector and a 10 mm 30 degrees scope was introduced transvaginally. With this technique, 20 cases were conducted with an average operating time of 62 minutes.

Forgione et al<sup>18</sup> described another technique in which a single incision is made in left upper quadrant for pneumoperitonium, colpotomy, retraction of gallbladder and clip application. The mean operating time was 136 minutes.

**DISCUSSIONS**

After analysis of different literature about SILS and NOTES, it is presumed that there is probably better acceptance of SILS, although high cost and technical expertise are two important drawbacks. But for NOTES, patient acceptance and concerns about safety and complications are major drawbacks. Older and uneducated patients and those undergone upper GI endoscopy or colonoscopy in past are more likely to refuse for the procedure. It is still unproven whether NOTES has a real advantage over traditional laparoscopy and SILS or not. SILS offers better cosmetics by reducing the multiple incisions used in conventional laparoscopy to a single umbilical incision. Multiple laparoscopic procedures can be simultaneously performed

**Table 1:** Published reports of NOTES and SILS cholecystectomies through the years 1997–2009

Authors	Approach to peritoneal cavity	Number of skin incision(s)	Number of skin trocar(s)	Number of attempted cases	Diagnosis	Success rate (%)	Complication(s) Reasons for conversion to standard LC	Average operating time (minutes)
NOTES cholecystectomy								
Bessler et al <sup>21</sup>	Transabdominal, transvaginal	1	3	1	Cholelithiasis	100	None	210
Marescaux et al <sup>8</sup>	Transabdominal, transvaginal	1	1	1	Cholelithiasis	100	None	180
Zornig et al	Transabdominal, transvaginal	1	1	14	Cholelithiasis	100	None	62
Forgione et al	Transabdominal, transvaginal	1	1	3	Acute cholecystitis	100	None	136
				3	Chronic cholecystitis	67	Hepatic injury	
				3	Cholelithiasis	100	None	
SILS cholecystectomy								
Tacchino et al <sup>5</sup>	Transabdominal	1	3	10	Cholelithiasis Cholecystitis	83	None Subcutaneous – hematomas (I) – Hepatic injury (I)	55 ± 7
Cuesta et al	Transabdominal	1	2	10	Cholelithiasis	100	None	70
Rao et al	Transabdominal	1	1	18	Cholelithiasis Choledocholithiasis	94 0	Difficult dissection Choledochoscope for CBD exploration <sup>2</sup>	40
Merchant et al <sup>16</sup>	Transabdominal	1	1	19	Cholelithiasis	100	None	45-90
				2	Acute cholecystitis	50	Difficult dissection	
Zhu et al	Transabdominal	2	2	22	Cholelithiasis	100	None	30-150
Romanelli et al	Transabdominal	1	1	4	Gallbladder polyps	100	None	68
				1	Cholelithiasis (history of pancreatitis)	100	None	
Gumbs et al	Transabdominal	1	3	2	NR	100	None	< 60
Palanivelu et al	Transabdominal	2	2	10	Cholelithiasis	60	Hemorrhage from – Cystic artery <sup>2</sup> – Difficult dissection <sup>2</sup> – Bile leak <sup>1</sup>	148
Navarra et al <sup>10</sup>	Transabdominal	1	2	30	NR	100	None	123
Piskun et al	Transabdominal	1	2	7	Cholelithiasis	100	None	NR
				3	Acute cholecystitis	100	None	

by SILS because of a common entry point. At time of difficulty, it is easier to convert SILS to conventional laparoscopy without changing the patient's position. Short operating time, early recovery, early return to work, less blood loss, and better tissue retrieval are the positive aspects of SILS. The overall patient acceptance is better compared to NOTES and conventional laparoscopic surgery. A few drawbacks of SILS include high cost of access port and hand instruments, slightly extraoperative time, and highly skilled and experienced surgical team to overcome the technical difficulties. But as the learning curve gets over, all the negative factors except the cost are likely to be compensated.

The attractive part of NOTES is that it is totally incision less, for which its acceptance in young and educated patients is relatively higher than the older people. Today, NOTES can be used for both abdominal and mediastinal surgery. Elderly people with previous history of upper GI endoscopy or colonoscopy dislike NOTES because of their previous painful experience. Young females hesitate to accept surgical procedure through vaginal canal. Even in the educated mass with relatively high acceptance for

NOTES, explaining the safety and complication rate of the procedure is difficult. There is no clear data available till now regarding its after-effects on sexual life and infertility due to transvaginal surgery. The second negative aspect is the high cost of sophisticated instruments. The third obstacle is the necessity of a highly skilled multidisciplinary team. Conventional laparoscopy can be conducted with the help of inexperienced assistants (interns or nurses), whereas for NOTES a whole team of experienced surgeons and gynecologist is required. The fourth limiting factor is operation time. Conducting NOTES leads to consumption of more human hour in term of person and time. The fifth drawback is that it is not so easy like SILS for conversion to traditional laparoscopy. The sixth drawback is the lack of sterilization and secure closure of internal incision in stomach or colon. A gastrointestinal leak is the most unwanted catastrophic outcome of NOTES. The seventh drawback is learning curve and till now no clear data is available regarding its safety and complications. As per review of all the above literature, it is presumed that disadvantages of NOTES outweigh the no-incision benefit.

## CONCLUSION

SILS and NOTES are both promising. In the present scenario, SILS has a little edge over NOTES. According to literatures, SILS is more acceptable than NOTES because of the above described reasons.

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