Laparoendoscopic single-site and natural orifice surgery in gynecology

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Laparoscopy

* Advantages: faster recovery, a shorter hospital stay, decreased analgesic requirements, lower peri-operative complications, improved quality of life

* Each working port: with inherent risk on bleeding, infection, concordant organ damage, hernia formation, and decreased cosmesis

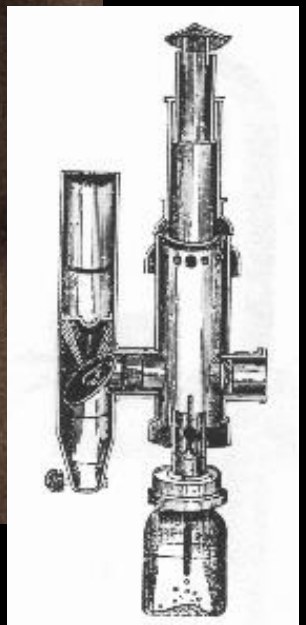
Minimally invasive surgery (MIS)

- ↓ Number of ports to perform the procedure
- The past two decades
- Benign & malignant gynecologic conditions

LESS

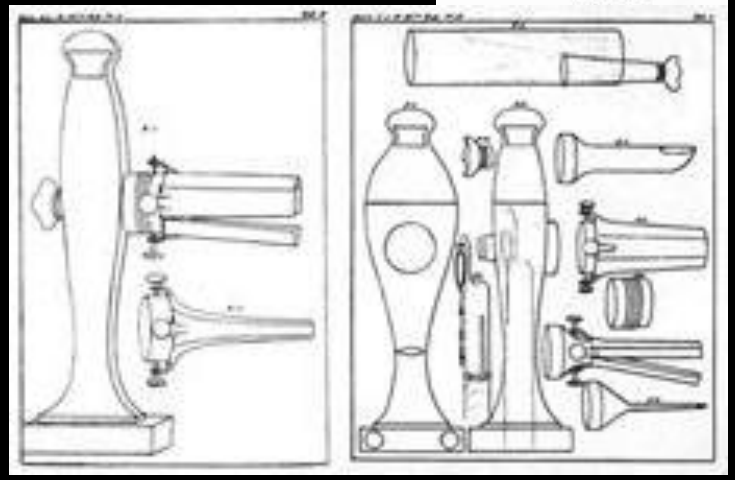
- Single-port laparoscopy (SPL) / laparoendoscopic single-site surgery (LESS)
  - ⇒ Less invasive alternative to conventional laparoscopy or robotic surgery
  - ⇒ Enhance the cosmetic benefits
  - ⇒ Minimizing the potential morbidity associated with multiple incisions

PORT SYSTEMS AND INSTRUMENTATION



Mid-1800s

- The ‘‘Lichtleiter’’ of Bozzini
- Antoine Jean Desormeaux, a French surgeon
- Mainly used for urologic applications
- Series of magnifying lens / Light source - lamp flame



PORT SYSTEMS AND INSTRUMENTATION

150 years later, Wheeless et al., sterilization

* > 4,000 women

1991, Pelosi and Pelosi, Hysterectomy

SPL - not standard technique in GYN surgery

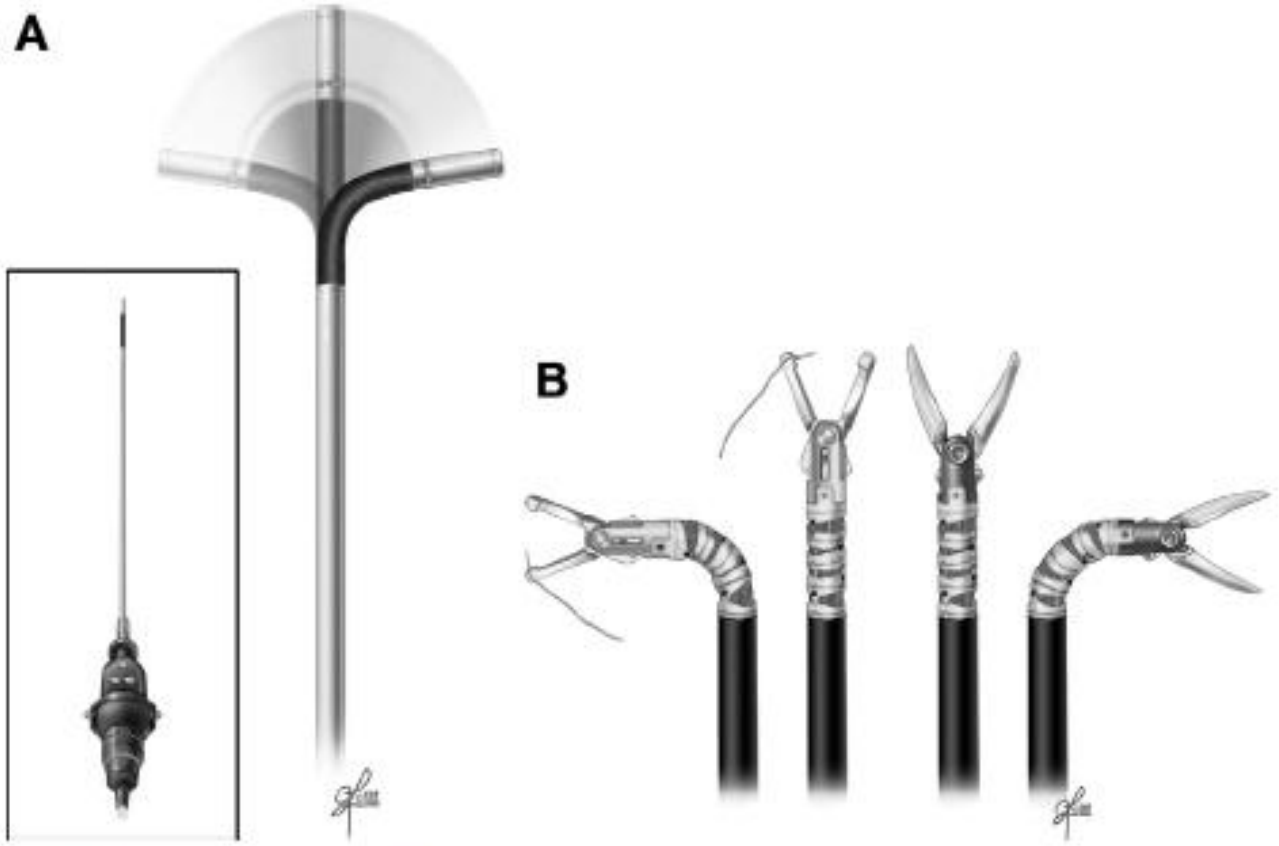
⇒ Lack of port systems specifically designed

⇒ Need for significant improvements in optical systems

⇒ Limited repertoire of instruments available

FIGURE 1

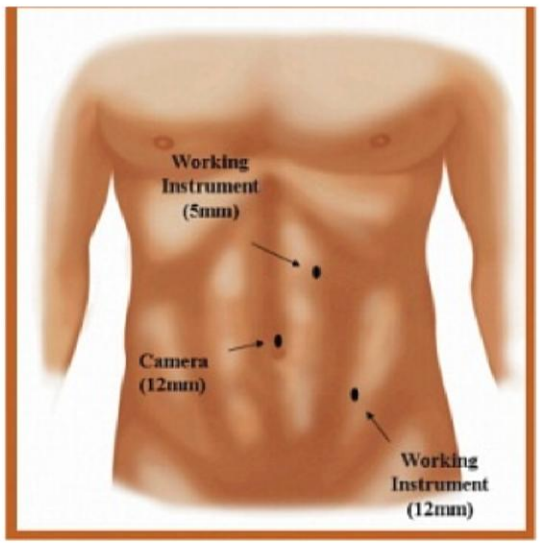
(**A**) Flexible laparoscope. (**B**) Flexible grasper and suturing device.

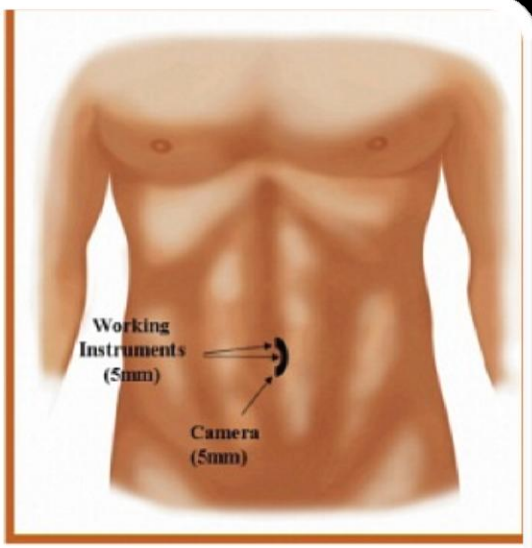


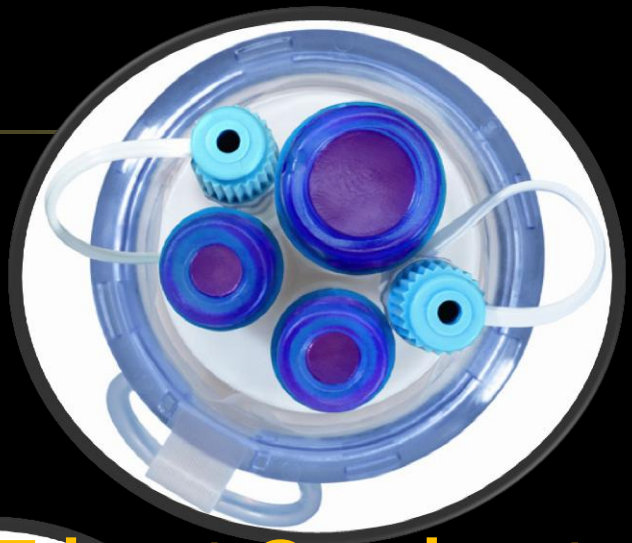
Escobar. Single-site and natural orifice surgery. Fertil Steril 2010.

single access port system

* Mmultiple instrument access port through a single incision => single use multichannel single-trocar systems
  * SILS port system (Covidien, Mansfield, MA)
  * Gelpoint (Applied Medical, Rancho Santa Margarita, CA)
  * Triport-Quadport (Advanced Surgical Concepts,Wicklow, Ireland)



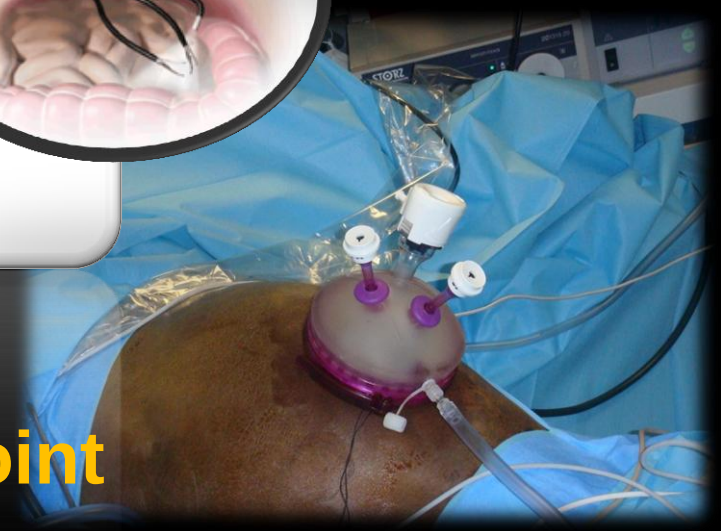




Triport-Quadport

(c)

SILS
port system



Gelpoint

single access port system

- New generation ports (recent 2–3 years):
  - ⇒ Dedicated CO2 insufflation channels → Integrate into the main structure of the port
  - ⇒ Detachable interfaces → ease of specimen removal
- Future systems: low profile, stabilization mechanism, attachment to the surgical bed

→ ↓ instrument clashing and/or crowding

→ Improve surgeon's dexterity & operability

FIGURE 2

General concept for a single port device where there is a separate entry site for the laparoscope and instruments.

Escobar. Single-site and natural orifice surgery. Fertil Steril 2010.

other surgical endoscopy technologies

- ‘‘Spyder’’ single port system, TransEnterix Inc (TransEnterix, Durham, NC).
- http://spidersurgery.com/

- Key:
  - a flexible catheter technology
  - “hybrid cross platform technology”

CLINICAL RESULTS
OF LAPAROENDOSCOPIC SINGLE SITE SURGERY

- Just begun to be elaborated
- Current experience: Porcine (most)/Humans (sparse)
- Greatest experience (Uro. literature, White et al.)
  - ⇒ 8x pts, SPL retroperitoneal surgery, 2007–2008
  - ⇒ 5x cryoablations, 1x partial nephrectomy, 1x metastectomy, 1x cyst decortication
  - ⇒ Retrospectively compared with standard LSC
  - ⇒ LESS pts. reported significantly ↓ pain after OP

Other observational study

* Kaouk & Goel, 7 patients, SPL partial nephrectomy, with daVinci surgical robot)

⇒ LESS: feasible for removing select exophytic tumors,
Minimal blood loss
Improved pain control

* Stein et al. Gel Port access platform

⇒ Improved spacing, flexibility, port placement, surgical field access

In General Surgery

- Podolsky et al., Alimentary Tract, 18-m experience and f/u, standard ‘‘very lowprofile’’ trocars & access devices, < 5% required the articulation
- 45 cholecystectomies (maintain dynamic retraction of GB & critical view throughout dissection)
- 10 colon resections (‘‘medial-to-lateral’’/‘‘lateral-to-medial’’ dissection was feasible, 1x hernia at f/u)
- 20 procedures involve the small bowel & omentum
- 8 gastric procedures & liver biopsy

GYNECOLOGIC SURGERY

TABLE 1 Broad demostrat feasibility: / Paucity of data

Single-port laparoscopy—LESS in gynecology.

Author	Year	Procedure	No. of cases	Comments
Wheeless (6)	1969	Tubal ligation	>4,000	Operative scope with 5 mm working channel, local analgesia with IV sedation
Pelosi et al. (8, 13)	1991, 1992	Hysterectomy, bilateral salpingo-oophorectomy	5	First complex pelvic surgery performed, 5 mm working channel off laparoscope, using a cannula for uterine manipulator
Kosumi et al. (14)	2001	Ovarian cystectomy	1	Pediatric patient, cyst aspirated and delivered with one trocar
Ghezzi et al. (15)	2005	Salpingectomy	10	Salpingectomy for ectopic pregnancy (EP), percutaneous sling suture used to retract affected tube
Fagotti et al. (16)	2009	Ovarian cystectomy	3	Enucleation of three large ovarian cysts by using a laparoendoscopic single-site approach with a new multiport trocar and standard laparoscopic instruments
Kim et al. (17)	2009	Adnexal surgery	24	Single port access laparoscopic adnexal surgery was successfully completed in 22 of 24 patients. Two failed cases
Yoon et al. (18)	2010	Ectopic pregnancy	20	All 20 cases of salpingectomy were carried out without a conversion to laparotomy
Lee et al. (19)	2009	Single-port assisted vaginal hysterectomy (SPA-LAVH)	24	All cases but 3 were performed exclusively through a single port. Operative time between initial cases ($n = 10$) and latter cases ($n = 14$) was not statistically significant
Yoon et al. (20)	2010	Subtotal hysterectomy	7	Morcellation of the uterus was accomplished with the device placed through the cervix
Fader et al. (21)	2009	Gynecologic cancer surgery and staging	13	Median operating time for hysterectomy ± lymphadenectomy cases was 168 minutes (range, 145–178 minutes). All cases successfully performed through a single port
Escobar et al. (22)	2010	Endometriosis and complex adnexal disease	9	Eight of 9 cases were completed successfully, without conversion to a standard laparoscopic approach or to laparotomy. An additional 3 mm extraumbilical port was required in one patient with stage 4 endometriosis. Seven out of 9 patients had previous abdominal surgery

Technology advanced tremendously

with overcome the instrument limitation

LESS in Gynechology

Wheeless (6)	1969	Tubal ligation	>4,000	Operative scope with 5 mm working channel, local analgesia with IV sedation
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Benign ovarian diseases

relatively low difficulty

LESS in Gynechology
- prospective evaluation

Kim et al. (17)	2009	Adnexal surgery	24	Single port access laparoscopic adnexal surgery was successfully completed in 22 of 24 patients. Two failed cases

- Estimate: feasibility, safety, operative outcomes
- SPA Lsc with wound retractor & surgical glove
- Post-op course: Uneventful in all/Median hospital stay: 1 D (1–3 D)/No complications observed at f/u
- 2 failed cases

⇒ One required an additional trocar for adequate adhesiolysis

⇒ One with borderline ovarian malignancy on frozen section pathologic study → staging laparotomy

Salpingectomy for ectopic pregnancy

Yoon et al. (18)	2010	Ectopic pregnancy

* 20 patients, 2010
* Pre-op: median hCG: 2,000 IU/Ml, GA 6 weeks + 3 days, BMI: 19.9 kg/m2
* Intra-OP: With ruptured: 25%, Median op time: 55 minutes, Blood loss: minimal
* median size: 3.1 cm (1.5–6.9 cm), 30-degree laparoscope, a flexible laparoscopic grasper, a 5-mm bipolar with a cutting blade
* Without address costs (many disposable instruments → increase the cost per case)

LAVH

- Lee et al., 24 patients, 2009
- Median op time: 119 minutes (90-255, *not statistically significant between initial 10x cases & later 14x cases*)

  Weight of the uterus: 347 g (225–732)

  EBL: 400 mL (100–1,000, *> anticipated*)
- All cases but three were performed exclusively through a single port

Lee et al. (19)	2009	Single-port assisted vaginal hysterectomy (SPA-LAVH)	24	All cases but 3 were performed exclusively through a single port. Operative time between initial cases (n = 10) and latter cases (n = 14) was not statistically significant

laparoscopic subtotal hysterectomies

Yoon et al. (20)	2010	Subtotal hysterectomy	7	Morcellation of the uterus was accomplished with the device placed through the cervix

* Transcervical introduction of a morcellator
* Average uterine weight: 300 g (168–427)

  op time: 157 minutes (140–233, ~ 35 minutes used for the actual morcellation)

  EBL: 200 mL (100–300)


Fig. 2

more complex procedures

- GYN cancers, hysterectomy with or without lymphadenectomy, n = 13
- Median op time: 168 minutes (145–178).
- All by single port

Fader et al. (21)	2009	Gynecologic cancer surgery and staging
Escobar et al. (22)	2010	Endometriosis and complex adnexal disease

- Complex adnexal masses, patients with previous surgery and endometriosis, n = 9
- All except one was completed successfully, without conversion to a standard LSC approach or lapa.

Comparement

LAVH

* Kim et al., Retrospective case control study
* 43 conventional LAVH <=> 43 SPA-LAVH

⇒ Op-time, EBL, Decline in Hb on POD 1, Hospitalized days: no sig. different

⇒ *Post-op pain(visual analog scale-based pain scores): significantly lower in the SPA-LAVH group at 24 & 36 hrs after surgery*

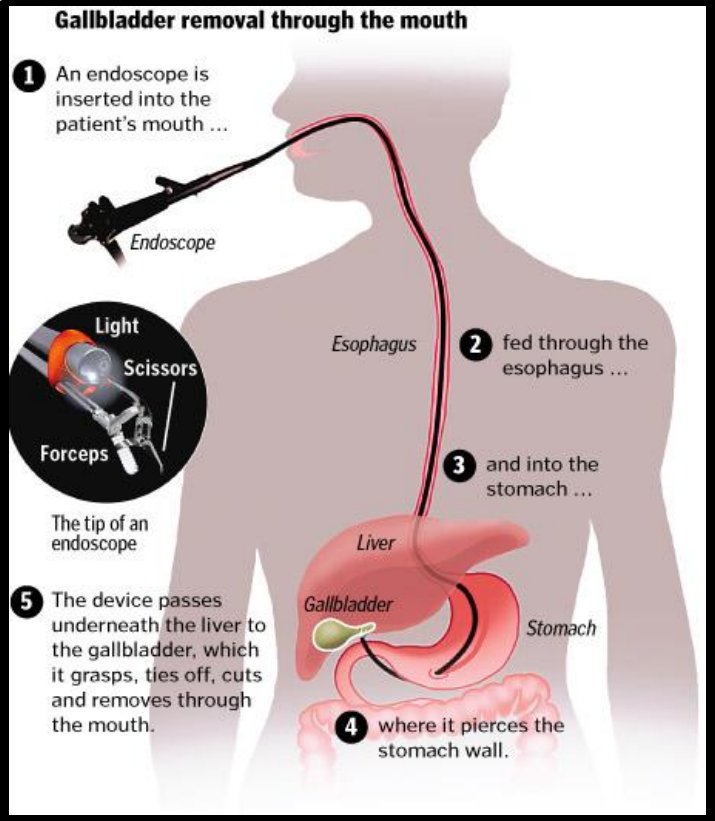
Adnexal surgery (Similar outcome)

- No prospective studies comparing outcomes with standard laparoscopy

- Current: The collection of prospective data recognizing for determine the relative merits of the LESS approach ⇔ conventional LSC

NATURAL ORIFICE TRANSLUMINAL ENDOSCOPIC SURGERY

* Emerging, experimental alternative => eliminates abdominal incisions & their related complication
* Combining endoscopic & Lsc => Dx/Tx abdominal pathology
* Flourished in GS (past few yrs)
* Emerged as a new concept of MIS



NOTES

1st published experience:

- Transvaginal endoscopic cholecystectomy, *Zorron et al., University Hospital of Teresopolis, Brazil.*

Later:

- similar procedures, *Bessler et al., Columbia University Medical Center, New York / Marescaux et al., University Louis Pasteur, Paris, France*

→ **Natural Orifice Surgery Consortium (NOSCAR) working group in 2006**

Notes in Gynecology

* Transvaginal endoscopy (culdoscopy)

⇒ visualize the abdominal and pelvic cavity

→ 1901, Dr. Dmitri von Ott, a Russian surgeon: ‘‘ventroscopy’’ ***through a colpotomy***

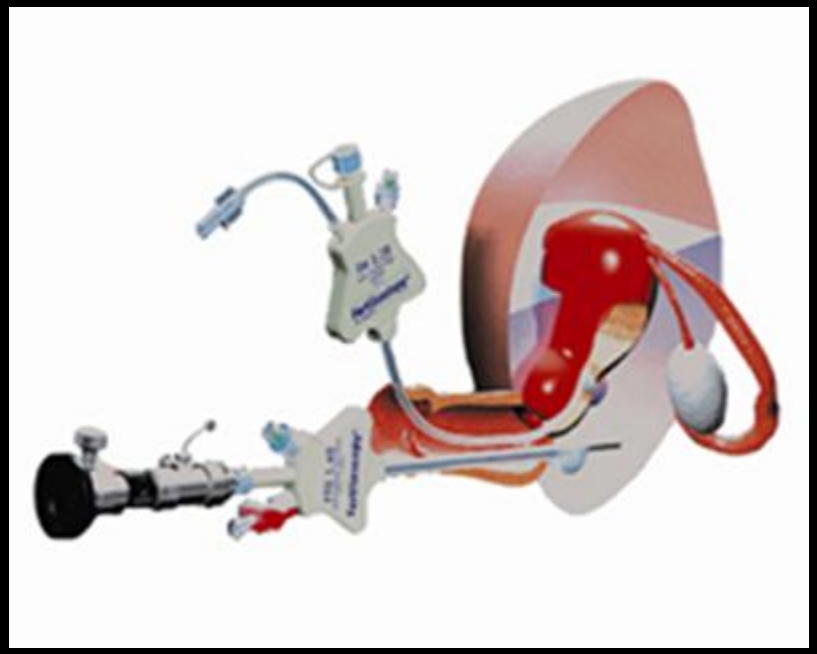
→ 1940, TeLinde, US, 1st rigid culdoscopy

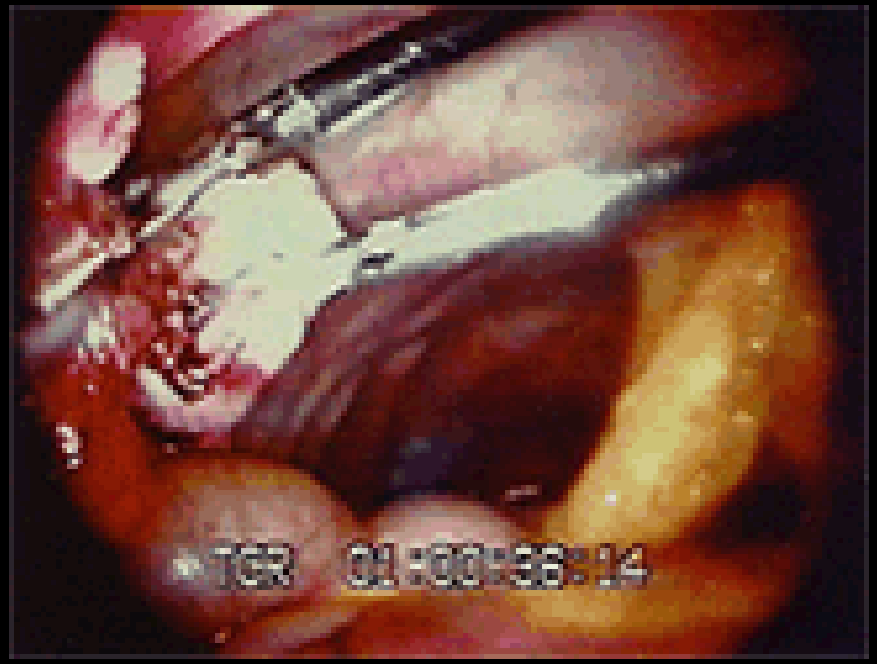
→ The next 20–30 years, culdoscopy flourished in the field of infertility (diagnostic & therapeutic)

→ More recently, reproductive infertility, transvaginal hydrolaparoscopy (THL) (diagnosis & treatment)

Transvaginal hydrolaparoscopy

- Contraindications: a fixed RV uterus, Hx of severe PID, pelvic masses in the ovaries or cul-de sac
- Office or outpatient surgical setting, tolerable





Transvaginal hydrolaparoscopy

- Dorsolithotomy
  - → LA (Cervical post. lip & Vaginal post. Fornix, 1–2 cm below the cervix)
  - → (through vagina, below origin of cervix, above rectum) → veress needle → 3-mm trocar → 30-degree endoscope
  - → with saline, L/R as distention medium
- Puncture site: not sutured(if hemostatic), abstain from intercourse, use of tampons for a few days

Transvaginal hydrolaparoscopy

Advantage:

* Mini-HSC with THL ⇔ HSG: sig. less post-op pain
* Decent visualization of ovaries & fallopian tubes
* minimally invasive nature and lowmorbidity

Disadvantage:

* Without Panoramic view of the pelvis

Transvaginal hydrolaparoscopy

Bowel injuries (A large retrospective survey):

- ⇒ 24 in 3,667 (0.65%), significantly decreased with increased experience ⇔ associated with conventional Lsc: 0.5%
- ⇒ The majority (92%): managed conservatively with antibiotics and hospital observation

Transvaginal hydrolaparoscopy

Accuracy (Compared to traditional Lsc):

* If complete evaluation of the adnexa (90%)

⇒ Tubal patency, Diagnoses of tubal disease, adhesions, endometriosis - Comparable for the Lsc

Other potential treatment modalities

⇒ Ovarian drilling (recent retrospective study demonstrated the feasibility)

A review of transvaginal endoscopy–culdoscopy

TABLE 2

NOTES/culdoscopy procedures.

Author	Year	Procedure	No. of cases	Comments
Paulson et al. (30)	1999	Flexible pelviscopy	11	2.2-mm flexible cystoscope used. 100% correlation of findings with laparoscopy
Burnett (42)	2000	Flexible pelviscopy	18	4.9-mm flexible choledochoscope, 83% of cases performed under IV sedation
Scott and Magos (43)	2001	Culdoscopy	20	Infertility patients, 3-mm 0-degree endoscope, using optical cannula, local analgesia
Tsin (44)	2001	Culdolaparoscopy	13	10–12-mm trocar placed in cul-de-sac, 3–5-mm abdominal ports operative procedures performed
Gordts et al. (45)	2005	Transvaginal laparoscopy	663	30-degree 2.9-mm rigid scope, lactate Ringer's was used for hydrodistension, failure to gain access in 3.4% of cases
Tsin et al. (46)	2007	Minilaparoscopy-assisted natural orifice surgery	100	Multiple operative procedures performed

Note: NOTES = natural orifice transluminal endoscopic surgery.

Escobar. Single-site and natural orifice surgery. Fertil Steril 2010.

Recent awareness on NOTES, new optics/flexible scopes/port system ➔ Facilitated NOTES across multiple surgical specialties including transvaginal

SINGLE PORT ROBOTIC SYSTEMS AND FUTURE DEVELOPMENTS

* Current da Vinci robotic system:
* Large, unwieldy, requiring a dedicated surgical team and experienced surgical assistants
* Need a minimum of instrument crowding → many technical challenges
* Patient-related limitations: ex. BMI

Robotic single port prototype

* The trocars are curved → instruments cross over to allow proper triangulation
* The robot software adjusts

for the apparent reversal

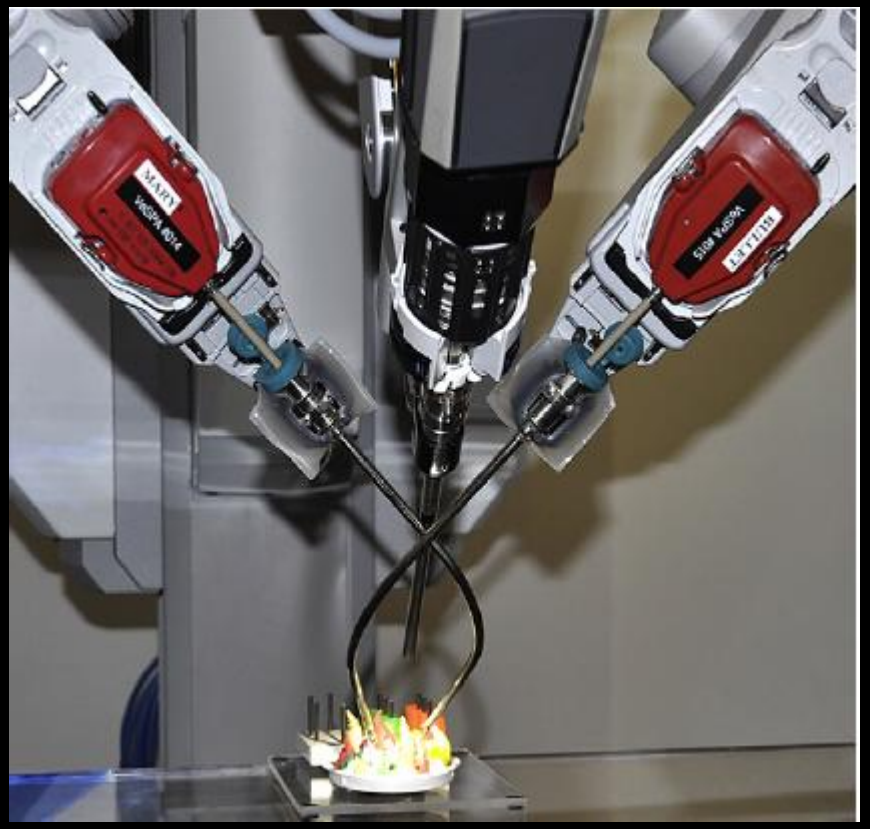
in hand movement

→ moving the left hand

→ Moving right instrument

→ moves the instrument

in the left field of view



Adaptability of the current da Vinci system

+

Perhaps best extraction incision/colpotomy for LESS

↓

makes robotic-assisted SPL surgery in Gyn feasible

Several new robotic offerings would apply to LESS are currently in the design or test phase

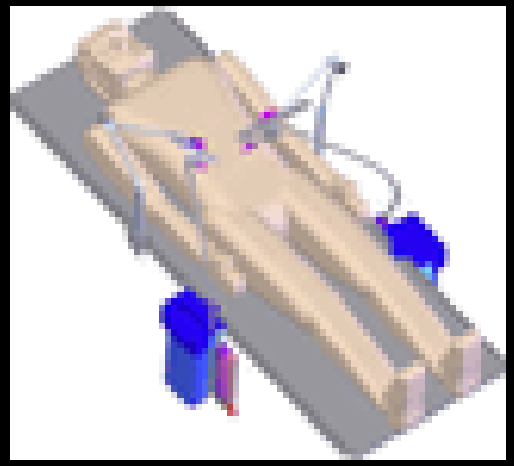
* An intracorporal instrument design, *Dachs & Peine*

⇒ 2 moveable joints with 6 degrees of freedom, without external pivoting motions

⇒ Significantly ↓ the need for external hardware

→ more room & flexibility to the surgical assistant

→ Minimize instrument crowding..... *Tan et al*.



- An endoluminal robotic system, Abbot et al.
- 1 flexible scope, 2 parallel articulating robotic arms
- In porcine models
  - ⇒ Met with various technical difficulties
  - ⇒ limit its application as a reliable surgical device
- 2nd-generation model has been proposed

- Future developments in port design & flexible robotics
- → simplify & enhance the practicality of robotic LESS
- → increasing its applicability.

Significantly smaller robotic platform + novel access ports + flexible endoscopes + instruments with strictly intracorporal articulation

➔ Robotic LESS as a viable surgical alternative for gyn procedures

In conclusion

* Lsc & robotic LESS: are currently in their infancy
* Existing/Growing literature: Feasibility of LESS, Benefits in improved cosmesis / pain control / quicker recovery / shorter hospitalization

⇒ If the existing technology become commonplace for the gynecologist → Greater strides will need

⇒ As the technology advances, the promise offered to the patient by LESS will be more fully realized

THANK YOU FOR LISTENINH