

# Place de la coelioscopie robot-assistée dans la prise en charge chirurgicale de l'endométriose pelvienne profonde. Revue de la littérature

## Robotic Assistance for Deep Infiltrating Endometriosis Surgery. Review of The Literature

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### Résumé

**Objectifs :** évaluer l'intérêt de la laparoscopie robot assistée dans la prise en charge chirurgicale de l'endométriose pelvienne profonde (EPP) et d'étudier les données per-opératoires.

**Méthodes :** il s'agit d'une revue de la littérature existante sur les différentes indications de la chirurgie robot-assistée et donne un aperçu des applications du robot dans l'endométriose pelvienne profonde. Nous abordons dans une première partie « L'Histoire de la coelioscopie robot-assistée », dans la deuxième partie les « Avantages et limites de la coelioscopie robot-assistée » ; la dernière partie concerne « L'Installation, la faisabilité et les données post opératoires particulièrement dans l'EPP ».

**Résultats :** les données de cette revue de la littérature ne nous ont pas permis de démontrer un réel avantage de telle ou telle approche chirurgicale, concernant les données per opératoires, les pertes sanguines et la durée d'hospitalisation. A l'heure actuelle, il n'existe pas d'étude montrant une différence, en termes de résultats, entre la laparoscopie robot-assistée et la laparoscopie conventionnelle dans la prise en charge de l'EPP.

**Conclusion :** l'intérêt de l'assistance robotisée dans la prise en charge d'EPP semble être prometteur. L'EPP est sans doute une des meilleures indications du robot en chirurgie gynécologique. Cependant les bénéfices pour les patientes restent à confirmer. La coelioscopie robot-assistée est l'évolution de la coelioscopie standard, reste à prouver son réel bénéfice.

### Mots clés

- ◆ Endométriose pelvienne profonde
- ◆ Laparoscopie robot assistée
- ◆ Robot Da Vinci system

### Abstract

**Backgrounds:** This study aimed to assess the interest in robot-assisted laparoscopy for deep infiltrating endometriosis and to investigate the perioperative results.

**Methods:** It's a review of the existing literature about the main surgical indications for robotic assisted surgery in endometriosis and gives an overview of the applications of robotic surgery in endometriosis. We talk about in first part "History of the robotic assisted laparoscopy", in second part "Advantages and Drawbacks of robotic assisted laparoscopy", and in the third part "Installation, feasibility and post-operative care, particularly in deep infiltrating endometriosis."

**Results:** In this data from the literature, we have not demonstrated a clear advantage for either approach in terms of complications, blood loss, and hospital stay. There are no studies showing the differences in outcomes for endometriosis between robotic-assisted and conventional laparoscopic surgery.

**Conclusion:** The interest in robot-assisted laparoscopy for deep infiltrating endometriosis seems to be promising. Probably, DIE is one of the best indications for robot assisted laparoscopy in gynecologic surgery. The benefits for patients still need to be confirmed. Robotic might be the evolution of standard laparoscopy and it's a real challenge to prove his efficiency.

### Keywords

- ◆ Deep infiltrating endometriosis
- ◆ Robot assisted laparoscopy
- ◆ Da Vinci system

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Endometriosis can be defined by the presence of endometrial glands and stroma outside of the uterus (1,2). It affects about 10 to 15% of the women in the reproductive period (3) and 50% of the infertile women (4). The prevalence is difficult to evaluate because the population used in the literature is not comparable and diagnostics criteria and therapeutics methods depends of the treating team (5).

The treatment is an ethical and public health issue. Endometriosis had important consequences on the way of life of the patients, invalidating because of symptoms of dyspareunia, chronic pain, dysuria, constipation and infertility. There is no correlation between the symptoms that patients describe and the lesion of endometriosis that are found. (2,6).

A multidisciplinary approach is mandatory with complete preoperative evaluation: clinical exam, pelvic ultrasound, magnetic resonance imaging (MRI) and rectal echo-endoscopy (2).

There are different treatment options that depend of patients' wishes and complaints. One option is the medical treatment (2) the other is surgical. When there are deep infiltrating lesions of endometriosis or when the medical treatment fails, it is better to operate which consists of a complete resection of the lesions or involved organs (2,7,8).

Deep infiltrating endometriosis (DIE) can involve vesico-vaginal septum, recto-vaginal septum and may lead to ureteral stenosis. Often adhesions and invasion of organs, vessels and nerves complicates the surgery. A specific informed consent preoperatively is mandatory. A standard laparoscopy is the gold standard for deep pelvic endometriosis surgery as shown by Darai and al in 2010 (8). Surgery for this major disease can be complex and should be managed by the appropriate multidisciplinary team, in reference center.

## History of the robotic assisted laparoscopy

In 2014 robotic assisted laparoscopy (RAL) was more widespread in the United States (US): 2000 cases in the US compared to 500 robots in Europe and 80 in France. The colleagues of urology were the pioneers in robotic surgery but the last years the technique is also expanding in gynecology. First robotic interventions were done by the Zeus system (9) but not commercialized anymore since 2003 (10). The first intervention with Da Vinci was performed in 1997. In 2004 the FDA (Food and Drug administration) approved the Da Vinci system in gynecology (11). Nowadays the robot is used as in oncology as in functional surgery (12). It combines 3 elements: the surgeon's console, a vision system and a patients' cart with robotic arms (3 in case of da Vinci and 4 in case of da Vinci S). One of them serves as support for the laparoscope of 12 mm to optical double. The latest model (da Vinci S or SI) can be equipped with a double console or a simulator. The Endowrist system gives 7 degrees of freedom in comparison of 5 in standard laparoscopy.

There are no national recommendations and only few articles are written about the indication of robotic surgery in the case of treatment of endometriosis. This chapter is a review of the existing literature about the main surgical indications for robotic assisted surgery in endometriosis and gives an overview of the applications of robotic surgery in endometriosis. We searched PubMed from 1997 to 2017 with the following keywords: robot/robotic/robotic assistance/robotically and endometriosis/deep infiltration. We selected articles published in English and French. Seventy-one publications related enthusiasm for this new technology that is promising for the treatment of deep infiltrating endometriosis.

## Advantages and Drawbacks of robotic assisted laparoscopy

Robotic surgery in gynecology has multiple indications: hysterectomy, myomectomy, tube reanastomosis, sacrocolpopexy, cystectomy, pelvic and para-aortic lymphadenectomy (13,14,15). There are multiple advantages: 3D vision, tremor filtration, image stability, 7 degrees of freedom, an ergonomic tool, increased accuracy in dissection and a fast learning curve for surgeons of conventional laparoscopy. (16,17,18,9,19) The main drawback is the high cost, a limited accessibility which cause difficulty to evaluate the learning curve of the surgeons (Fig 1).

## Installation, feasibility and post-operative care, particularly in deep infiltrating endometriosis

In the beginning, around 2008, there were case reports that describe the technique of resection of nodules of deep infiltrating endometriosis (DIE). They showed the feasibility of the surgical technique. In 2008, Chammas described a case of cystectomy with resection of rectal nodule without ileostomy (20). Nezhat and Rogers (14) wrote about 2 patients with DIE who underwent a robot-assisted trachelectomy and cystectomy in 2011 and 5 cases of deep infiltrating endometriosis with involvement of the bowel and ureters (21) (Fig 2 et 3).

The French team of Lille, Bot Robin et al, has published in 2011 (10) a study who showed the feasibility of an unifocal resection of an endometrial nodule by robotic surgery. They published 6 cases (2 vesicovaginal nodules and 4 rectovaginal nodules) with a median operation time of 173 minutes and a median hospitalization time of 3 days. No conversions to laparotomy, no perioperative or postoperative complications except one patient developed bilateral pyelonephritis with a hematoma in the vesicovaginal space who could be resolved by an echo guided ponction and antibiotic therapy (Tableau 1).

A good long term follow up could be showed by Carvalho in 2012 after an efficient technique and no major complications (22). The rate of laparoconversion seems diminished in comparison of standard laparoscopy, showed by Nehzat et al (23) in 2010 (0%) and Collinet et al in 2014 (0,6%) (15) versus 10% in the literature. In the literature, particularly with these young patients who were already multiple times operated and in a context of infertility (8,24,25). It seems that there is no difference between postoperative complications and long term results for robotic surgery compared with standard laparoscopy (23,26).

A series of 78 cases was published in 2010 by Nezhat et al (23) who compared standard laparoscopy (38 cases) and robotic laparoscopy (40 cases) for resection of pelvic endometriosis whatever the stage of disease is (2010). It's the only study that gives a comparison between the two techniques in the case of endometriosis. Age, body mass index and stage of endometriosis were comparable in both groups. Time of surgery and anesthesia was longer in the robotic's group. (191 vs 159 minutes) but the perioperative and postoperative complications as well as the blood loss were similar. Nezhat didn't show difference for stage I and II and advice to use the robotic technique for severe stage (III et IV).

In 2013 Siesto et al demonstrated equal results: his series of robotic procedures for DIE represents the largest currently available and it helps to promote robotics as a safe and attractive alternative to accomplish a comprehensive surgical treatment of DIE, especially when bowel or bladder resections are needed (27).

Nezhat compared laparoscopy to robotic assisted laparoscopy in 2014 without difference between the two groups and also demonstrate the same. No difference between the two groups for the perioperative and postoperative complications but we withhold a longer operative time and time of hospitalization in the robotic laparoscopy group (26).

SERGS (The Society of European Robotic Gynecological Surgery) (28) displays the largest study trends: a decrease of the risk of laparotomy conversion (0.6%) and a lower morbidity for complex and multiple procedures (1.8% of re intervention). RAL seems to be promising for deep infiltrating endometriosis stage 3 and 4, without increase of operative time, per- and postoperative complications and blood loss. There are limitations of this study in 2014: it's a retrospective study, without comparative cases, associated to a lack of long-term follow-up.

### Hysterectomy and endometriosis

Concerning the definitive surgical management of women with severe endometriosis. Hysterectomy was practiced in this cohort study of 43 women, Bredaiwy and al (29) has showed in 2013 that patients were treated with robot-assisted laparoscopic hysterectomy with unilateral or bilateral salpingo-oophorectomy for stage III (n = 19) or stage IV (n = 24) disease. Robot-assisted laparoscopic surgery appears to be also a reasonably safe and feasible method. To confirm this data from the literature, Patkowsky and al showed in 2013 that perioperative outcomes for laparoscopic and robotic hysterectomy for benign indications appears to be equivalent (30).

### Endometriosis and recto-vaginal infiltration

Concerning endometriosis with colorectal involvement, in 2012, Ercoli and al, (31) were the first to demonstrate the feasibility of the colorectal shaving in deep infiltrating endometriosis with robotic surgery: 22 cases in one year without major perioperative and postoperative complications. Then Diguisto in 2015 (32) compared rectal shaving and colorectal resection: there is not difference between the two groups concerning postoperative pain and remission rate. Pellegrino and al (33) did a complete resection of a nodule of the recto-vaginal section without per- and postoperative complications and blood loss. RAL in DIE seems to be a good technique, reliable, performed by trained operators, even if it's risky surgery with important complication.

### Endometriosis and ureteral compression or vesico vaginal nodule infiltrated

Concerning RAL and ureteral compression or deep nodule of vesico-vaginal septum: robotics in urology is already practiced currently and demonstrated its effectiveness (34,35,36). Anna et al in 2011, described two case reports of ureteral re-implantation with RAL. Both of the surgeries were successful, without perioperative or postoperative complications. The specific literature is very poor. But in the data, technical ureteral surgeries were practiced without major complication.

### Endometriosis and fertility

Concerning the impact of fertility in endometriosis: RAL has a benefit for the massive adhesions (12), less postoperative pain, the hospitalization stay and a early return to daily activities (37). A study published in 2013 showed a higher rate of fertility with the RAL but it was a very small group of patients (38).

In total, there are no meta-analyses to answer the question whether the surgical excision of severe endometriosis will enhance pregnancy rates. However recent studies of better quality and larger numbers suggest an improvement in pregnancy rates. RAL seems to be suitable to infertility surgery (39) but without randomized trials, the place of this technique has not been already proved.

## Conclusion

Deep infiltrating endometriosis is probably one of the best indications for RAL. RAL is a technology that emerged from the fusion and improvement of laparoscopy and robotic. In this data from the literature, we have not demonstrated a clear advantage for either approach in terms of complications, blood loss, and hospital stay. There are no studies showing the differences in outcomes for endometriosis between robotic-assisted and conventional laparoscopic surgery. Robotic might be the evolution of standard laparoscopy and it's a real challenge to prove his efficiency. Standard laparoscopy has already proven its good results. RAL has to be done by well-trained surgeons and seems to be efficient for DIE endometriosis stage III or IV. To the future clinical research has to be done to compare studies for each procedure with the conventional laparoscopy versus robotic assisted laparoscopy and study the morbidity and the fertility of each procedure.

## Déclaration d'intérêts

Les auteurs déclarent ne pas avoir de conflits d'intérêts.

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## Légende des figures

Figure 1 : Laparoscopy and robotic assisted laparoscopy.

Figure 2 : Installation.

Figure 3 : Installation of the patient, and incision point (Da Vinci).

## Légende des tableaux

Tableau 1 : Review of deep infiltrating endometriosis and Robotic assisted laparoscopy.



<u>Laparoscopy</u>	<u>Robotic assisted laparoscopy</u>
2D vision	3D vision
4 degrees of freedom	7 degrees of freedom
Tremor	Tremor filtration
Ergonomic	Ergonomic tool
	
(CHRU Lille)	(CHRU Lille)

Figure 1 : Laparoscopy and robotic assisted laparoscopy.



	
	(Da VINCI)
<ul style="list-style-type: none"> <li>- 3D high definition vision</li> <li>- Tiny <u>wristed</u> instruments that bend and rotate greater than human hand with 3 or 4 arms one for the endoscope 12mm</li> <li>- Ergonomically designed consol where the surgeon sits while operating</li> <li>- Patient side cart. Patient is positioned during surgery</li> <li>- Video monitor in the operating room to guides doctors during surgery</li> </ul>	

Figure 2 : Installation.

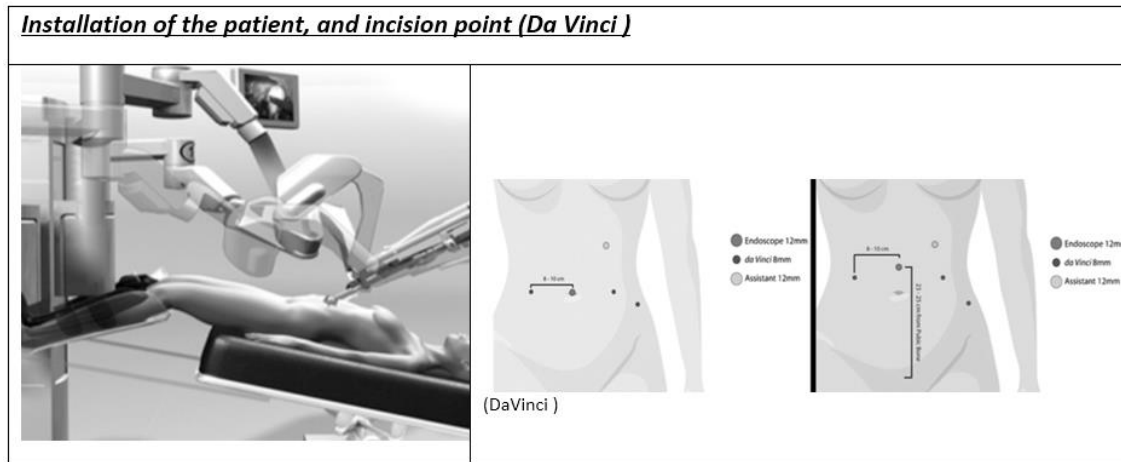


Figure 3 : Installation of the patient, and incision point (Da Vinci).

Name of authors	Year of publication	Number of cases	Title of the study	Results
DIGUISTO and al	2015	28 - 6 digestive procedure - 22 shaving procedure	Laparoscopie robot-assistée pour endométriose colorectale : morbidité de la résection digestive et du shaving	<ul style="list-style-type: none"> <li>- has compare shaving rectal and colorectal resection</li> <li>- no difference between the two groups concerning post-operative pain and remission rate.</li> <li>- Operative time was significantly shorter (<math>P=0.0002</math>) and estimated blood loss was significantly lower (200 ml vs 560 ml, <math>P=0.04</math>) in the shaving procedure</li> <li>- Length of hospital stay was longer (<math>P=0.0001</math>) in the resection group</li> <li>- At the two-month re-evaluation, there was no significant difference between the two groups</li> </ul>
NEZHAT and al	2014	420 2004 et 2012 147 robotic procedure 273 classic procedure	Robotic-assisted laparoscopy vs conventional laparoscopy for the treatment of advanced stage endometriosis.	<ul style="list-style-type: none"> <li>- No difference between the two groups</li> <li>- No difference between the two groups for the post-operative et per operative complication</li> <li>- a longer time of surgery and time of hospitalization. (26)</li> </ul>
SEGRS	2014	164 endometriosis stage IV 8 centers - rectum (n=88) - bladder (n=23) - ureter and uterosacral ligaments (n=115) - hysterectomy (n=28).	Robot-assisted laparoscopy for deep infiltrating endometriosis: international multicentric retrospective study	<ul style="list-style-type: none"> <li>- it's the largest study trends,</li> <li>- it decreases the risk of lap conversion (0.6%),</li> <li>- shows a lower morbidity for complex and multiple procedures (1.8% of re intervention).</li> <li>- RAL seems to be promising for deep endometriosis infiltration stage 3 and 4, without increase surgical time, per and post-operative complication, and blood loss.</li> </ul>
SIESTO and al	2013	47 - 19 bowel resections - 23 rectovaginal septum resections - 5 bladder resections	Robotic surgery for deep endometriosis: a paradigm shift.	<ul style="list-style-type: none"> <li>- a five-year cohort study</li> <li>- without complication</li> <li>- robotics as a safe and attractive alternative to accomplish a comprehensive surgical treatment of DIE, especially when bowel or bladder resections are needed</li> </ul>
PELLEGRINO and al	2013	25	Robotic Shaving Technique in 25 Patients Affected by Deep Infiltrating Endometriosis of the Rectovaginal Space	<ul style="list-style-type: none"> <li>- without complications concerning per and post-operative complication and blood loss</li> </ul>
BREDAIWIY and al	2013	43 cohort study 19 stage III 24 stage IV	Robotic-assisted hysterectomy for the management of severe endometriosis: a retrospective review of short-term surgical outcomes.	<ul style="list-style-type: none"> <li>- Robot-assisted laparoscopic surgery appears to be also a reasonably safe and feasible method.</li> </ul>
ERCOLI and al	2012	22	Robotic treatment of colorectal endometriosis: technique, feasibility and short-term results.	<ul style="list-style-type: none"> <li>- the first to demonstrate the feasibility of the colorectal shaving in Deep Infiltration Endometriosis with robotic surgery</li> <li>- without major per operative and post-operative complications.</li> </ul>
BOT ROBIN and al	2011	6	Early evaluation of the feasibility of robot-assisted laparoscopy in the surgical treatment of deep infiltrating endometriosis]	<ul style="list-style-type: none"> <li>- Time of surgery: 173 minutes</li> <li>- median time of hospitalization 3 days</li> <li>- No conversions to laparotomy</li> <li>- No perioperative or postoperative complications</li> <li>- expect one patient developed bilateral pyelonephritis with a hematoma in the vesicovaginal space who could be resolved by an echoguided ponction and antibiotic therapy.</li> </ul>
NEZHAT and al	2010	78 - 38 cases comparison classic laparoscopy - 40 cases robotic laparoscopy	Robotic versus standard laparoscopy for the treatment of endometriosis. Fertil Steril.	<ul style="list-style-type: none"> <li>- It's only study that gives a comparison between the two techniques in the case of endometriosis.</li> <li>- Age, body mass index, stage of endometriosis were comparable in both groups.</li> <li>- Time of surgery and anesthesia was longer in the robotic's groupe. (191 vs 159 minutes)</li> <li>- the complication per operative post-operative and blood loss was similar</li> </ul>

Tableau 1 : Review of deep infiltrating endometriosis and Robotic assisted laparoscopy.