The use of CO₂ Laser in surgical procedures in gynecology is clinically-based, and is used successfully in laparoscopy and other surgical approaches. CO₂ Laser is a valuable tool in the treatment of several pathologies, as endometriosis, uterine fibroids, gynecological neoplasias and benign pathologies of the female lower genital tract, e.g. Bartholin’s gland. The following list presents selected publications from the last years, pointing out the advantages of using CO₂ laser for various applications in gynecology.
Energy to Healthcare

1990
- Introduced UltraPulse® CO₂ and VersaPulse® Holmium laser systems
- patented WaveGuide delivery system for CO₂ laser

1996
- Introduced VersaPulse® C

2000
- Introduced VersaPulse® PowerSuite™, world’s first 100W Holmium laser for BPH

2009
- Introduced AcuPulse™ with SurgiTouch

2010
- Introduced VersaPulse P20

2012
- Introduced AcuPulse WaveGuide

2012
- Introduced
  - AcuPulse DUO
  - FiberLase Robotic DIG
  - MicroLase Fiber
  - FiberLase GYN Handpieces

2014
- Introduced
  - Lumenis Pulse 120H
  - Xpeeda Fiber
  - SlimLine 200 D/F/L Fiber

2015
- Introduced
  - UltraPulse DUO
  - Lumenis Pulse 100H
  - Lumenis Pulse 50H

2016
- Introduced
  - Lumenis Pulse 30H
  - Suction hand-piece
  - Otolase Fiber Delivery System

A Heritage of Innovation
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- Endometriosis.................................................................................5

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## CO₂ Laser in Gynecology - an Overview

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</table>
| Laser technology and applications in gynaecology | J Obstet Gynaecol, 33(3): 225-31 | Adelman MR, Tsai LJ, Tangchitnob EP, Kahn BS | 2013 | ▶ Gas and solid-state lasers are frequently used in surgical applications. CO₂ laser is one of the most common examples of gas lasers utilized in gynecological surgery  
▶ CO₂ laser is considered to be the most versatile, safe, and easily delivered for endoscopic use, serving as a cutting and coagulating instrument with minimal destruction of adjacent tissues  
▶ Laser technology provides alternative methods for treating various conditions in gynecology with minimal destruction of adjacent tissues | N/A |
| Fiber-Optic Technologies in Laser-Based Therapeutics: Threads for a Cure | Curr Pharm Biotechno, 11(4):384-97 | Wang Z, Chocat N | 2010 | ▶ Until recently, CO₂ laser surgery, renowned for its precision and efficiency, was limited to open surgeries by the lack of delivery fibers  
▶ The advanced fibers are assessed for their ability to transmit CO₂ laser at adequate power level and for their applications in a range of clinical areas  
▶ The combination of new CO₂ fiber technology with the CO₂ unique features can reduce unnecessary damage to collateral tissues and coagulation of small blood vessels in order to reduce bleeding during procedure | N/A |
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</table>
| Treatment efficacy for pain complaints in women with endometriosis  | Lasers Med Sci ;30(1):147-52        | Posadzka E, Jach R, Pityński K, Jablonski MJ | 2015 | › Evaluation of the efficacy of laparoscopic treatment with the use of CO$_2$ laser ablation versus electro-ablation with regards to pain complaints in 48 women in 2 groups  
› The Numeric Rating Scale (NRS) for pain intensity was reduced in both groups after 3 months. 6 months postoperatively, a statistically significant increase in pain intensity was noted in both groups  
› Both CO$_2$ laser ablation and electro-ablation seem to be effective in the treatment of endometriosis-related dysmenorrhea, whereas the intensity of other pain complaints has remained on the same level | Lumenis laser system |
› Excision surgery can be used to treat the disease more comprehensively than ablation technique  
› With the free-beam CO$_2$ laser, higher power (in the range of 12–15 W) can increase the precision of the laser as a cutting instrument | N/A |

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› Incision width and depth of the laser were significantly less than monopolar cut at most power settings, as well as less collateral thermal damage width and higher efficiency of the laser compared with monopolar coagulation  
› CO₂ laser energy delivered via a flexible fiber system would exhibit greater surgical precision than monopolar electrosurgery, in both cutting and coagulation modes | Lumenis laser system |
| Video-assisted laparoscopy for the detection and diagnosis of endometriosis: safety, reliability, and invasiveness | Int J Womens Health ;4:383-93         | Schipper E, Nezhat C                      | 2012 | › Review of laparoscopic diagnosis of endometriosis from the pre-operative evaluation during the surgical technique and postsurgical care of patients suspected of having endometriosis  
› Safe laparoscopic excision of an endometriotic lesion requires acute awareness of surrounding structures, and it is often necessary to cut adhesions in order to have a thorough evaluation of the pelvis  
› In dense adhesions, the CO₂ laser is preferred due to its limited thermal spread and precise invasion | N/A                        |
## Endometriosis

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<td>The pregnancy rate was 41% at a follow-up time of 8.3 months. Recurrence of a small endometrioma was observed in only 1 case (2%)</td>
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<td>The combined technique (stripping and ablation) has proved not to be deleterious to the ovary, and takes the best elements from both techniques, while avoiding the risks</td>
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<tr>
<td>The impact on ovarian reserve after laparoscopic ovarian cystectomy versus three-stage management in patients with endometriomas: a prospective randomized study</td>
<td>Fertil Steril, 94(1):71-7</td>
<td>Tsolakidis D, Pados G, Vavilis D, Athanatos D, Tsalikis T, Giannakou A, Tarlatzis BC</td>
<td>2010</td>
<td>Investigation of the effect of two different laparoscopic methods on ovarian reserve in patients with ovarian endometriomas in 20 patients in 2 groups: laparoscopic cystectomy for endometrioma (group 1) or the “three-step procedure” which consists of laparoscopic cyst drainage followed by hormone treatment and a laparoscopic CO2 vaporization (group 2)</td>
<td>Lumenis laser system</td>
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<td>Mean of Anti-Mullerian Hormone (AMH) levels in serum was significantly reduced from 3.9 to 2.9 ng/mL in group 1 compared with the reduction from 4.5 to 3.99 ng/mL in group 2</td>
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<td>Ovarian reserve determined by AMH levels in serum is less diminished after the “three-step procedure” compared with cystectomy of endometriomas</td>
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<tr>
<td>Outcome after multidisciplinary CO₂ laser laparoscopic excision of deep infiltrating colorectal endometriosis</td>
<td>Reprod Biomed Online ;18(2):282-9</td>
<td>Meuleman C, D’Hoore A, Van Cleynenbreugel B, Bek N, D’Hooghe T</td>
<td>2009</td>
<td>Evaluation of clinical outcome after using a multidisciplinary CO₂ laser laparoscopic excision of deep endometriosis in 56 patients. Gynaecological pain, Quality of Life (QOL) and sexual activity improved significantly during 29 months after surgery. Direct complications from surgery occurred in only 5%. 4 years after surgery, recurrence rate was 7%, and pregnancy rate was 70%. Multidisciplinary CO₂ laser laparoscopic excision of deep endometriosis with colorectal extension improves pain, quality of life and sexuality with high fertility and low complication and recurrence rates.</td>
<td>Lumenis laser system</td>
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<tr>
<td>Laparoscopic management of ovarian endometriomas: a critical review of current practice</td>
<td>Curr Opin Obstet Gynecol, 12(4):309-15</td>
<td>Jones KD, Sutton CJ</td>
<td>2000</td>
<td>Identifying the evidence from published literature for the laparoscopic management of ovarian endometriomas. Laparoscopic surgery is equivalent to laparotomy. The operation of choice is still unresolved whichever outcome measure is used to assess efficacy. The best results from ablative techniques are achieved using a CO₂ laser as part of a two-stage procedure combined with adjuvant analogue therapy.</td>
<td>N/A</td>
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## Gynecological Neoplasias

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› The risk factors for recurrence were age over 45 years, type of VAIN and Human papillomavirus (HPV) type 16 infection. The lesion with more recurrence was VAIN III, with 15.26%  
› CO₂ laser vaporization technique is effective in treatment of Vaginal intraepithelial neoplasia (VAIN) | Lumenis laser system          |
› All VAIN patients achieved remission after 2 episodes of laser treatment, with 85.7% complete regression in group 1 and 54.5% in group 2. All patients had no recurrence during a mean follow-up time of 25 months. Laser treatments were well tolerated with no major side-effects  
› CO₂ Laser vaporization may be a useful option for the treatment of VAIN after hysterectomy | N/A                            |
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</table>
| The efficacy of long term follow-up and CO₂ laser conization as conservative management in patients with cervical cancer stage FIGO IA1 | Gynecology, 1:3              | Fallani MG, Pieralli A, Lozza V, Tarani S, Bianchi C, Peyrov Sajad SS, Fambrini M, Penna C | 2013 | › Evaluating the efficacy of CO₂ laser excision as a therapeutical method for stage IA1 cervical squamous carcinoma in 60 patients  
› Conservative management with laser therapy was effective in more than 90% of the patients. When disease persistence was detected (7%), patients underwent repeated laser CO₂ conization and followed-up without demolitive intervention  
› Laser CO₂ conization alone appeared to be an effective and safe treatment for patients with cervical cancer. Careful post-treatment follow-up should be guaranteed                                                                 | Lumenis laser system   |
| Use of CO₂ laser vaporization for the treatment of high-grade vaginal intraepithelial neoplasia | J Low Genit Tract Dis., 17(1):23-7 | Perrotta M, Marchitelli CE, Velazco AF, Tauscher P, Lopez G, Peremateu MS | 2013 | › Analyzing the clinicopathologic characteristics, diagnostic methodology, and therapeutic results obtained with the use of CO₂ laser vaporization for high-grade vaginal intraepithelial neoplasia (VAIN) in 21 patients  
› 18 subjects were disease free after a single application of CO₂ laser vaporization (cure rate of 86%). 3 patients (14%) presented with persistence/recurrence and required a second application  
› CO₂ laser vaporization was effective for the initial treatment of high-grade VAIN. However, a long-term follow-up is required due to the recurrent character of this disease                                                                 | Lumenis laser system   |
### Gynecological Neoplasias

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› The overall cure rate after a follow-up time of 54 months was 91.5%. A third excisional procedure was performed in 8 cases of persistent-recurrent HG-CIN with a disease-free subsequent follow-up of 38 months  
› CO₂ laser cylindrical or conical re-excision performed according to the time of reappearance of the disease seems to be a promising conservative approach for persistent-recurrent HG-CIN | N/A                   |
› From the patients that underwent conization, 2 patients (2.5%) were detected with lymph-vascular space invasion (LVSNI). 5 patients (7%) were found to have involved margins and from those, the majority was managed by a second conization. 4 patients (6.6%) with recurrence were observed during follow-up of 54 months, all of them with low-grade squamous intraepithelial lesion (LSIL). No cases of invasive disease or high-grade squamous intraepithelial lesion (HSIL) were encountered  
› CO₂ Laser conization is a safe and effective mode of treatment for women suffering from MIC and wish to retain their fertility | Lumenis laser system |
### Gynecological Neoplasias

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› The cure rate for a single treatment was 97.5% and a satisfactory colposcopic follow-up was possible in 99.4% of treated patients  
› CO₂ laser vaporization represents a safe alternative for conization in the treatment of high-grade CIN. Colposcopic expertise is essential for adequate preoperative selection of cases | Lumenis laser system |
### Flexible Carbon Dioxide Laser Fiber Versus Ultrasonic Scalpel in Robot-Assisted Laparoscopic Myomectomy

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| Flexible Carbon Dioxide Laser Fiber Versus Ultrasonic Scalpel in Robot-Assisted Laparoscopic Myomectomy | J Minim Invasive Gynecol ;22(7):1183-90 | Choussein S, Srouji SS, Farland LV, Gargiulo AR | 2015 | › Comparing the effectiveness and safety of a flexible CO<sub>2</sub> laser fiber to the ultrasonic scalpel when employed through a robotic surgical system in 236 women in 2 groups  
› Estimated blood loss and operative time were comparable between the 2 groups, whereas length of hospital stay was significantly shorter in CO<sub>2</sub> group. No difference in the risk for complications was found between the 2 groups  
› Robot-assisted laparoscopic myomectomy with a flexible CO<sub>2</sub> laser fiber is safe and has comparable operative outcomes to the ultrasonic scalpel. The small size and flexibility of this device allows robotic surgeons to employ safe focal energy without sacrificing operative ergonomics |

### Robot-assisted laparoscopic myomectomy and adenomyomectomy with a flexible CO<sub>2</sub> laser device

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| Robot-assisted laparoscopic myomectomy and adenomyomectomy with a flexible CO<sub>2</sub> laser device | J Robot Surg;7(2):157-62 | Barton SE, Gargiulo AR | 2013 | › Description of the use of robot-assisted laparoscopic myomectomy or focal adenomyomectomy with CO<sub>2</sub> laser in 13 women with symptomatic uterine fibroids and/or adenomyosis  
› The average operating time was 169 minutes and the average estimated blood loss was 25 ml. No perioperative complications were observed  
› Preliminary experience with CO<sub>2</sub> laser has comparable operative outcomes to conventional laparoscopy, with safety and minimal lateral thermal spread combined with the enhanced precision which appears ideal for reproductive surgical applications |

Laser system: N/A
## Bartholin's Gland

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<tr>
<td>Treatment of Bartholin gland cyst with CO₂ laser</td>
<td>Einstein (Sao Paulo), 14(1):25-9</td>
<td>Speck NM, Boechat KP, Santos GM, Ribalta JC</td>
<td>2016</td>
<td>Describing the results of treatment with CO₂ laser for Bartholin's gland cysts in 31 women in an outpatient clinic</td>
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<td>There were no complications. 5 patients (16.1%) had recurrence of the cyst and underwent a second successful session</td>
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<td>CO₂ laser surgery was effective to treat Bartholin's gland cysts with minimal or no complications, and can be performed at an outpatient setting</td>
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<td>All procedures had a short operative time, with no complications. Only 1 (2.0%) out of 49 patients required a hemostatic suture for bleeding. Only 6 patients (12.2%) reported pain one day after surgery. Healing was rapid and excellent in all cases, with no wound infection, scarring or stenosis. Preoperative symptoms reduced or disappeared in all cases. No recurrence was observed and no re-intervention was needed</td>
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<td>CO₂ laser surgery provides several advantages over traditional surgery, as it reduces patient discomfort, improves short- and long-term outcomes, and optimizes cost-effectiveness</td>
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The cure rate after a single laser treatment was 86.6%. There were only 3 cases of minor intraoperative bleeding (2.4%), and 17 recurrences (13.4%) within a mean follow-up of 14.6 months  
CO₂ vaporization seems to be a safe and effective procedure for the treatment of Bartholin's gland cysts | N/A          |
Median operative time was 17 minutes. 3 cases of intraoperative major bleeding were observed (1.5%). The cure rate was 95.7%. 9 patients had recurrent disease and underwent reintervention with a 100% cure rate  
CO₂ laser vaporization of Bartholin's gland cyst represents a safe and effective procedure with complete healing and positive follow-up outcomes | Lumenis laser system |
### CO2 laser treatment for Bartholin's gland cyst

- **Evaluation of CO2 laser treatment when used for excisional and ablative procedures in the treatment of Bartholin’s gland cyst in 111 patients**

  - 1 month after surgery, all patients showed a complete regeneration of the vulvar tissue. Complications were observed in only 5 patients (4.5%). In a 28-months follow-up period, 2 cases of cyst relapses were observed (1.8%) and underwent a second successful CO2 laser surgery.

  - CO2 laser was shown to be an effective device for the treatment of Bartholin’s gland cyst, with successful therapeutic results. The incidence of intra- and post-operative complications was less frequent than with the classical surgical procedure.

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› 1 month after surgery, all patients showed a complete regeneration of the vulvar tissue. Complications were observed in only 5 patients (4.5%). In a 28-months follow-up period, 2 cases of cyst relapses were observed (1.8%) and underwent a second successful CO2 laser surgery  
› CO2 laser was shown to be an effective device for the treatment of Bartholin’s gland cyst, with successful therapeutic results. The incidence of intra- and post-operative complications was less frequent than with the classical surgical procedure | Lumenis laser system |
Risk information: CO₂ lasers (10.6 µm wavelength) are intended solely for use by trained physicians. Incorrect treatment settings or misuse of the technology can present risk of serious injury to patient and operating personnel. The use of Lumenis CO₂ laser is contraindicated where a clinical procedure is limited by anesthesia requirements, site access, or other general operative considerations. The use of Lumenis CO₂ laser is contraindicated for patients who are not candidates for general surgery, or when local or spinal epidural anesthesia is inappropriate, laparoscopic applications where laparoscopy is contraindicated. Risks may include excessive thermal injury and infection. Read and understand the CO₂ systems and accessories operator manuals for a complete list of intended use, contraindications and risks.