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# Surgical Treatment of Endometriosis Via Laser Laparoscopy

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Therefore, there is low risk of thermal damage to underlying or surrounding tissue. In addition to precision, the laser permits a bloodless incision by coagulating small (0.5 mm) blood vessels.

For the procedures discussed herein, the CO<sub>2</sub> laser (Sharplan 733, Advanced Surgical Technologies, Allendale, NJ) was used. The CO<sub>2</sub> laser was used either through the operating channel of the laparoscope or through a specially adapted second puncture trocar.<sup>1</sup> A micromanipulator coupler was used, and attached to the laparoscope or to the probe. A 28- or 18-cm zinc arsenide lens was used in the coupler to focus the laser beam.

The laser laparoscopes used for these procedures were the Eder Laser Laparoscope and Micromanipulator (Edward Weck Co., Research Triangle Park, NC), the Wolf Laser Laparoscope and Micromanipulator (Richard Wolf Medical Instruments Corp., Rosemont, IL), and the (Karl Storz-Endoscopy America, Inc., Culver City, CA).

The only contributing factor to infertility in this patient group was endometriosis. Other causes of infertility (hormonal, male factor, etc.) had been eliminated as the probable cause of the patients' infertility.

The possible need for laparotomy or more extensive additional procedures like colostomy or hysterectomy were discussed preoperatively with the patient. Before embarking on the treating of a large endometrioma, careful laparoscopic assessment was done to reduce the chance of draining a pelvic malignancy. The cysts that had the appearance of endometriomas were first aspirated for cytology. Peritoneal washing would have been performed if suspicion of malignancy existed.

The procedures were performed under general endotracheal anesthesia with patients placed in the lithotomy position. The bladder was drained, and a cervical cannula was placed for manipulation of the uterus and for intraoperative injection of diluted indigo carmine. Each patient received 1 gm Mefoxin (Merck Sharp & Dohme, West Point, PA) intravenously at the start of the procedure, as a prophylactic single dose.

After pneumoperitoneum induction, the operating laparoscope was inserted intraumbilically. A 5-mm second-puncture trocar was then inserted in the midline approximately 2 to 4 cm above the symphysis pubis. An atraumatic alligator grasping forceps (Eder Instruments Company, Chicago, IL) was then introduced through the second puncture site for traction or manipulation as needed during surgery. When necessary, a third incision

was made either in the midline, one-third of the way between the laparoscope and suprapubic trocars, or along the suprapubic line, 2 to 3 inches from the second trocar. This third incision allowed the insertion of the special CO<sub>2</sub> laser probe, a suction-irrigator, or other auxiliary instruments as needed during surgery.

A focused beam of 6000 to 12,000 W (0.5 mm spot size, at a 15- to 30-W setting) was employed to vaporize endometriosis implants from the ovary, pelvic sidewall, cul-de-sac, tubes, uterosacral ligaments, bladder flap, and peritoneum or capsule of endometriomas. The continuous or pulse mode of the CO<sub>2</sub> laser was used. Pulse mode was used for delicate dissection, particularly around the ureters, bowels, and vessels. Pulse mode was approximately 1.7 per second with a shutter opening of 0.05 to 0.1 seconds.

Endometriomas up to 7 cm in diameter and any peritubal or periovarian adhesions were also treated through laser lysis.

When the cavity was opened, the internal wall was examined for excrescent tumor. In the event one had been found, a frozen section would have been performed. Large endometriomas were aspirated and irrigated several times with a double-bore needle (Rocket of London, London, UK), routinely used for ovum retrieval in *in vitro* fertilization programs. The endometriomas were then bivalved and the capsule dissected and removed when possible. Any residual capsule was then vaporized. This reduced the possibility that the ablation of the capsule would be incomplete. Endometriomas' capsules can be up to 4 to 5 mm thick, which makes vaporizing the whole capsule difficult and time-consuming.

If oozing occurred from the lysis area, a Jackson-Pratt drain (Goleta, CA) was inserted in the abdominal cavity and removed the next day. The patients were routinely discharged 2 to 4 hours after surgery.

## RESULTS

Of the 102 patients, only 2 required draining. Operating time was between 20 minutes and 3½ hours, according to the stage of the disease. In a few instances patients stayed longer, up to 20 hours after surgery (one-night stay).

The duration of infertility in the patients ranged from 12 to 192 months. Fourteen (13.1%) patients had experienced endometriosis-related infertility for 12 to 23 months before surgery. For

**Table 3. Distribution of Pregnancy in 102 Patients with Endometriosis**

Age	No. of patients	No. of pregnancies	%
20-25	19	12	24.1
25-30	31	20	32.0
30-35	43	27	43.0
35-41	9	3	4.8
Total	102	62	

The CO<sub>2</sub> laser laparoscope was first used by Bruhat et al.<sup>17</sup> in France and Tadir et al.<sup>18</sup> in Israel. Daniell and Pittaway<sup>1</sup> provided the impetus for the use of this equipment in the United States. Subsequent studies by Kelly and Roberts,<sup>7</sup> Feste,<sup>19</sup> and Martin<sup>8</sup> suggest the value of these techniques. Keye and Dixon<sup>20</sup> have introduced the use of the argon laser for photocoagulation of endometriosis, and Lomano<sup>21</sup> has suggested the use of the neodymium YAG for this purpose. Neither the argon nor the YAG has been used for extensive laparoscopic dissection. The current work of Joffe et al.<sup>22</sup> in the development of an artificial sapphire tip for the YAG laser in extensive intraabdominal surgery at laparotomy has the potential for laparoscopic fiber-directed dissection.

When the CO<sub>2</sub> laser is used through the laparoscope, the surgeon's line of vision and the beam are almost coincident. They are almost coincident because the line of vision and the line of the CO<sub>2</sub> laser beam emerge from two different channels. This is an important point for one to consider to prevent any inadvertent tissue damage.

The high intensity of the scope's light source causes some diminution of the HeNe aiming beam. Any additional lights for photographic purposes further obscure the visibility of the HeNe beam. Gradually the systems are becoming more sophisticated, and the instrument companies are providing more efficient auxiliary instruments.

We have avoided the significant back strain associated with operating directly through the laparoscope by refining videomonitoring techniques. With this technique, which we have been calling videolasroscopy, we have excised endometriomas of up to 7 cm in size and in stage IV/AFS endometriosis. With the use of video-monitoring systems, we have decreased the time and back strain of direct laparoscopic visualization.

The use of a video camera, video recorder, and a high-resolution video monitor in conjunction with the laser laparoscopic procedures provide two benefits. Fatigue, brought on by long, complicated procedures can be minimized as the surgeon works in a more comfortable, upright posture, working from the monitor rather than by direct eye contact with the scope. Secondly, a video recording of the procedure is available for future reference. Karl Storz's Videocamera (Karl Storz-Endoscopy America, Inc.) and the Wolf Video Camera (Richard Wolf Medical Instruments Corp.) were used interchangeably. Both of these cameras provide good resolution and good-quality videotapes.

The second puncture laser probe has an 8-mm double ring channel which allows the simultaneous transmission of laser beam and insufflation of fresh CO<sub>2</sub>. Control of insufflation is facilitated through two valves located at the base of the probe. Insufflation of fresh CO<sub>2</sub> through the laser channel (probe) at a rate of 2 l/minute causes smoke to be forced out of the laser's path, and moisture does not accumulate on the focusing lens or mirror in the coupler.

The drawbacks encountered with using the CO<sub>2</sub> laser directly through the laparoscope include inadequate smoke evacuation and diminution of the visibility of the red helium/neon guide.

Advantages of laser laparoscopy over laparotomy are a faster recovery period and a shorter hospital stay. Minimal handling of the tissue and less exposure to air reduce secondary dryness of tissue, and elimination of glove powder during a laparotomy probably diminishes the formation of postoperative adhesions.

Furthermore, susceptibility to bacterial contamination and oozing from the abdominal wall incision may be increased by laparotomy, in comparison with laparoscopy, and may enhance adhesion formation. The use of the laser in preference to cautery or surgical excision of endometrioma may forestall the formation of postoperative adhesions, to which the ovaries are vulnerable. Finally, use of the laser can preclude the

**Table 4. Duration of Infertility in 102 Patients with Endometriosis**

No. of months	No. of patients	%
12-23	14	13.1
24-59	48	47
59 mos. or more	40	39.2

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