11 Laser laparoscopy in the treatment of endometriosis

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During the past two decades we have witnessed considerable technical progress in infertility surgery. Microsurgical techniques introduced new concepts in surgical operations and engendered a respect for the delicate reproductive structures. The main aim of these procedures was to reduce the incidence of tubal and ovarian adhesions by careful tissue handling, the avoidance of surface desiccation and meticulous haemostasis. Recent research has suggested that a reduction in peritoneal mesothelial plasminogen activator activity (PAA) in the presence of trauma, infection or tissue ischaemia is the likely pathway in postsurgical adhesion formation. Any surgical insult is associated with trauma but the biological interaction between lasers and living tissue minimizes this. Infection is less likely with laparoscopy than laparotomy and the ischaemia produced by surgical knots is avoided by the use of lasers. The advent of operative laparoscopic techniques has replaced the need for open surgery in many patients.

This chapter traces the history and development of laser laparoscopy and explains why laser laparoscopy represents an advance in the surgical treatment of endometriosis.

THE HISTORY AND DEVELOPMENT OF LASER LAPAROSCOPY

In the 1950s Arthur Schawlow and Charles Townes co-authored a paper explaining how stimulated emission could be used to generate and amplify visible light. It took a further ten years until the first working laser, a ruby laser, was produced by Theodore Maiman in 1960. The first surgical laser was used to photocoagulate retinal lesions. It was replaced in ophthalmology in the mid-1960s by the argon laser because of its more useful absorption
properties. The neodymium:YAG laser was developed in 1961 for photo-
coagulation of large tumours and like the argon laser its emissions could be
passed down flexible endoscopes for the control of bleeding from peptic
ulcers. The carbon dioxide (CO₂) laser, probably the most widely used laser
in gynaecology, was developed in 1964 by Patel and his colleagues working
at Bell Laboratories in California for use in the communications industry.

The first reported use of the CO₂ laser via a laparoscope came from
Professor Bruhat and his team working at the Polyclinique in Clermont-
Ferrand, France. Having pioneered this new form of surgical treatment they
turned their attention to advanced operative laparoscopic techniques using
electrodiathermy, and have only recently renewed their interest in laser
surgery. Meanwhile, other centres started experimenting with laser lapa-
roscopy and prototype instruments and techniques were developed independ-
ently in Israel, the United States, the United Kingdom and Belgium. One of the
disadvantages of the CO₂ laser energy is that, until recently, it
could only be passed down rigid systems that are rather cumbersome.
Professor William Keye, working at the University of Utah, investigated an
argon laser that could be aimed and fired through flexible fibre-optic fibres.
He performed initial animal experiments and then used it on a series of
patients with endometriosis.

The neodymium:YAG laser had already been used endoscopically for
endometrial ablation via the hysteroscope, where the relatively deep
penetration and the ability to function in a fluid medium was a distinct
advantage. The introduction of artificial sapphire tips allowed the laser energy
to focus at a point source and produced a type of laser scalpel, at the same
time retaining the advantage of flexible fibres and the ability to work in
haemorrhagic areas. This is a valuable surgical property, since energy at this
wavelength is not absorbed by blood whereas the CO₂ laser is rendered
virtually ineffective in the presence of haemorrhage.

The latest flexible-fibre laser to be developed has been the potassium-
titanyl phosphate laser (KTP/532). With a wavelength of 532 nm it is a
frequency-doubled Nd:YAG laser in which the KTP laser beam is generated
by optically pumping Nd:YAG laser energy through a crystal of KTP. Laser
energy at this wavelength has the same tissue effect as the argon laser but
is associated with greater power and appears to be more effective when used
laparoscopically. This laser was introduced by James Daniell in Nashville,
Tennessee, who also introduced CO₂ laser laparoscopy to North America.

Newer lasers have been developed that provide greater precision but do
not confer any great advantage for the treatment of endometriosis. An
excimer laser is so precise that it can create serial notches in a human hair
but unfortunately there is no thermal effect and when it is used laparoscopically
there is inevitably small-vessel haemorrhage that cannot be stemmed by the
laser energy. Before discussing the technical aspects and results of treatment
with these different lasers, it is important to be certain that an accurate
diagnosis is made at the initial laparoscopy.

DIAGNOSTIC LAPAROSCOPY AND STAGING
The major advantage of laser laparoscopy in endometriosis lies in the ability
to provide treatment at the same time as the diagnosis is made. It is important,