State of the Art Laser Surgery

What is a laser?

LASER stands for Light Amplification by Stimulated Emission of Radiation. A laser is an opto-electronic device that produces highly concentrated light rays. Laser power may range from milliWatts (in CD-ROM drives and laser pointers) to dozens of Watts (industrial and medical applications) and over trillions of Watts (pulsed lasers in scientific and military applications).

What is laser surgery?

Interaction of laser light with tissue provides a fundamentally different approach to surgery. In laser surgery, a highly focused laser beam can efficiently ablate (either vaporize or chip away) the living tissue. At the same time, it seals (welds) capillaries, small blood vessels, lymphatics, and nerve endings, with significant benefits to both patients and surgeons.

What is the most efficient soft-tissue surgical laser?

Soft Tissue Laser Surgery is different from Hard Tissue Laser Surgery (bones and teeth in dentistry) and Laser Eye Surgery (eye sight corrective surgeries) by particular types of lasers. Lasers differ from each other by the wavelength of light they produce. The most commonly used surgical laser in soft tissue surgery is the CO₂ laser. The CO₂ laser wavelength (10.6 micrometers) is highly absorbed by water contained in soft tissue. Because of its outstanding versatility and precision, the CO₂ surgical laser is the most efficient and dominant soft tissue surgical laser since the 1960s. Laser surgery is widely practiced in many applications of human as well as veterinary medicine.

Laser surgery benefits for patients

Less Bleeding: As it cuts, the laser seals small blood vessels. This drastic reduction in bleeding enables a number of new surgical procedures that are not practical with conventional scalpel.

Less Pain: The CO₂ laser beam seals nerve endings and lymphatics, resulting in less edema and pain. The patient experiences a far more comfortable post-operative recovery.

Reduced risk of infection: This is one of the unique features of the CO₂ laser beam. It efficiently kills bacteria in its path, producing a sterilizing effect.

Quicker recovery time: Reduced risk of infection, less bleeding, less pain and less swelling often allow the patient a far quicker recovery after the surgery.

Laser surgery benefits for surgeons

Unique surgical capabilities: Laser surgery improves many surgical procedures by making them simpler and reducing risk. This enables surgeries that are not practical with conventional methods.

Enhanced visibility of the surgical field: The laser light seals capillaries and small blood vessels as it cuts, thereby dramatically reducing bleeding. This results in a much clearer and drier surgical site.

Increased precision and control: The focal spot size of the beam may be adjusted down to a small fraction of a millimeter or expanded for a much wider coverage. The laser power may be set for rapid removal of relatively large tissue amounts, or adjusted to remove only one cell layer at a time.

Reduction of surgery time: The hemostatic effect of the laser beam and the improved visibility of the surgical field often reduce the duration of the surgery.
Veterinary Laser Surgery

General surgery procedures:


"...laser surgery offers better hemostasis and visibility, less post-operative swelling, and decreased post-operative pain. In certain procedures, better hemostasis and visibility will reduce overall surgical time."

Timothy L. Holt, DVM and Fred A Mann, DVM, MS
"Soft Tissue Application of Lasers"

"The carbon dioxide laser is a very effective tool for treating diseases of the perianal region. The skin of the perianal region is thin and sensitive. The carbon dioxide laser offers a 'no touch' method of excising these lesions, which helps decrease postoperative discomfort and irritation. The carbon dioxide laser is very effective in controlling hemorrhage from vessels smaller than 0.5 mm. This is sufficient in controlling most hemorrhage caused from the rich blood supply of the perianal region. The perianal region is contaminated with bacteria. The carbon dioxide laser photothermally vaporizes bacteria, so that bacterial numbers are decreased, which helps reduce the risk of postoperative infections. These factors help the patient recover quicker and return to function sooner.

The light emitted from a carbon dioxide laser has a wavelength of 10,600 nm, which is in the far-infrared light spectrum. This wavelength of light is highly absorbed by water, creating a thermal effect. Because all soft tissues in the body are composed mainly of water, the carbon dioxide laser penetrates very shallow into tissue, and there is very little collateral thermal damage. This interaction makes the carbon dioxide laser a useful tool for incising, excising, and photoablation of soft tissue and allows for fine, controlled dissection of tissue. The axiom of 'what you see is what you get' applies to the properties of the carbon dioxide laser. Finally, the carbon dioxide laser seems to have a lower learning curve when compared with other types of lasers."

Bert A. Shelley, DVM, MS
"Use of the carbon dioxide laser for perianal and rectal surgery."

Ophthalmology surgery procedures:


"The CO2 laser does have a valuable role for vaporization of eyelid masses, particularly when located adjacent to the medial canthus making scalp excision and closure difficult; for treating diffuse eyelid papillomatosis; and for safely extending surgical margins after excision or debulking of neoplasms, such as fibrosarcoma and squamous cell carcinomad of the eyelid, limbus, or nictitans."

Margi A. Gilmour, DVM, ACVO

ENT and oral surgery procedures:


"Carbon dioxide (CO2) lasers are used in oral surgery for precisely cutting or vaporizing soft tissue with hemostasis. CO2 lasers intended for dental applications are CW lasers. The CO2 wavelength is absorbed by the water content of oral tissues. Thermal necrosis zones of 100 to 300 lm at cut tissue edges are typical, providing better oral structure safety compared with other lasers (neodymium:yttrium aluminum garnet [Nd:YAG], argon, and diode), which may penetrate up to several millimeters.
With the CO₂ laser, 'what you see is what you get' compared with the Nd:YAG laser where no immediately visible change appears in the tissue surrounding the zone of vaporization. With the Nd:YAG laser, it is difficult to estimate the true extent of thermal necrosis. This advantage of replacing traditional excisional techniques with CO₂ laser ablation permits removal of the damaged epithelium with as little as 0.1 to 0.2 mm of reversible thermal injury to the submucosa. CO₂ lasers are used for oral, soft tissue procedures, such as gingivectomy, gingivoplasty, frenectomy, and biopsy. Tissue vaporization is more efficient with the CO₂ laser than with other lasers discussed because of the direct absorption of this wavelength by water.

Jan Bellow s, DVM
"Laser Use in Veterinary Dentistry"

Dermatology surgery procedures:


"The CO₂ laser proved to be an excellent choice for laser surgery because of the ability to limit the zones of damage to microsurgery with little to no collateral damage. This laser is the primary laser in use today in veterinary dermatology. The operator can easily control the device for use in three ways: skin incision, lesion excision, and ablation. It can be readily controlled for precise microsurgery or can be used for ablating larger lesions. Because of its high absorption by water, there is little to no collateral tissue damage with this laser when used properly. ...the ability for the operator to control the effect of the laser beam essentially to the area that you can see with no collateral damage, has led to wide use of this laser in many areas of medicine, including veterinary dermatology ..."

David Duclos, DVM
"Lasers in Veterinary Dermatology"

Avian and exotic surgery procedures:


"There are many benefits of the CO₂ laser in exotic animal practice. Their use is limited only by the imagination... The benefits of carbon dioxide (CO₂) laser use in exotics include decreased blood loss, pain, surgery time, and healing time. Because the CO₂ laser seals small vessels as it cuts, there is a decreased blood loss, which is of great benefit because many of the exotic species are quite small and therefore have a small blood volume. The use of CO₂ lasers for surgery also decreases pain because they seal nerve endings as they cut, which may also decrease selfinduced trauma after surgery. Decreased pain may also lessen postsurgical fear and anxiety. Lasers make surgery safer and provide a quicker recovery period. Ablation of cutaneous masses is simplified, with minimal loss of blood. Many exotics develop a capsule surrounding an abscess. If this capsule is not removed or is only partially removed, there is a high recurrence rate. The CO₂ laser allows for the ablation of the capsule."

Agnes E. Rupley, DVM and Terri Parrott-Nenezian, DVM
"The Use of Surgical Lasers in Exotic and Avian Practice"

Equine surgery procedures:


"... surgical lasers have extended the operative precision, range, and morbidity reduction .... Equine upper airway surgery has also been revolutionized, and there are certainly many applications yet to be developed."

Stephen W. Crane, DVM
"Lasers in Medicine and Surgery"