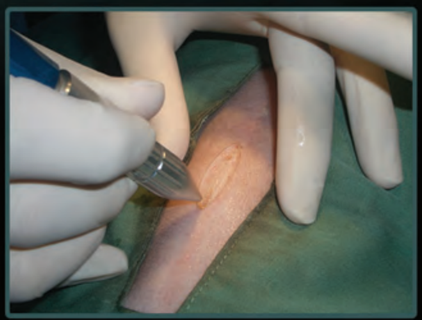
Aesculight

FLEXIBLE FIBER CO_2 LASER SURGERY

The Educational Series
As Seen in Veterinary Practice News

Special Edition






Surgical CO_2 laser demystified

By Peter Vitruk, Ph.D.
For The Education Center

This article highlights the practical aspects of learning and using flexible fiber surgical CO_2 lasers in everyday veterinary soft tissue surgeries.

The much-praised clinical benefits and ease of use of the American-made Luxar and Aesculight flexible fiber surgical CO_2 lasers with ergonomic scalpel-like handpieces are enjoyed by more than 12,000 physicians, dentists and veterinarians worldwide. [See bloodless laser blepharoplasty in progress in **Figure 1**; and bloodless laser frenectomy in progress in **Figure 2**.

Figure 3a. Stenotic nares CO_2 laser surgery, pre-operative view, photo courtesy of John C. Godbold Jr., DVM, Jackson, Tenn.

Figure 3b. Stenotic CO_2 laser surgery, intra—and immediately post-operative view, photo courtesy of John C. Godbold Jr., DVM, Jackson, Tenn.

The flexible fiber CO_2 laser has also made many veterinary soft-tissue procedures much simpler and far more enjoyable; consider bloodless stenotic nares laser surgery (**Figures 3a**, pre-operative, and **3b**, intra- and immediately post-operative.

The ability of the CO_2 laser's 10,600 nm wavelength to vaporize water-rich soft-tissue makes it a true "What You See Is What You Get" surgical laser with maximum precision; its minimal collateral thermal effects are sufficient for sealing blood vessels, lymphatics and nerve endings; the surface bacteria are efficiently destroyed on incision/ablation margins.

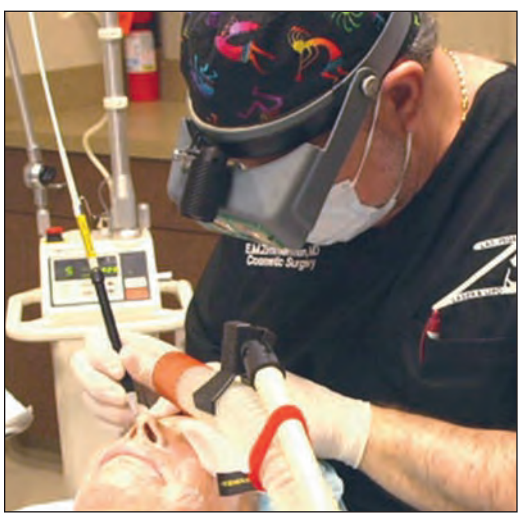
The CO_2 laser is *the only* practical soft-tissue surgical laser where the laser beam is used directly to cut, ablate and photo-coagulate the soft tissue.

Why Flexible Fiber CO_2 Laser?

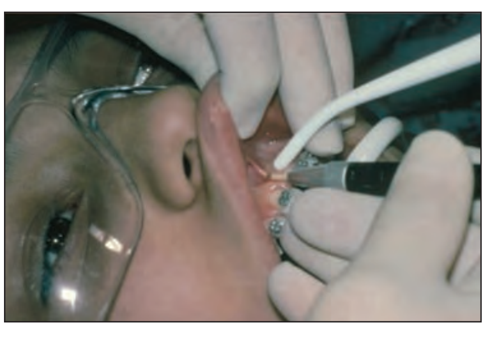
Since the early days of CO_2 lasers (during 1970-80s), the articulated arm beam delivery system was, and still remains, a barrier for wide adoption of this surgical technology. The paradigm change for CO_2 laser surgery was brought about by the invention of the flexible fiber CO_2 laser beam delivery system in 1988 (K. Laakmann and M. Levy, Luxar Corp., Washington USA).

Commercialized and perfected in the U.S. for scalpel-like functionality through extensive cooperation among physicians, dentists, veterinarians and laser engineers at Luxar Corp. and Aesculight LLC in Washington, the modern-day flexible fiber veterinary CO_2 laser handpiece (**Figures 4a and 4b**) is pen-sized, disposable-free, autoclaveable and is easily adaptable to switch back-and-forth between incision with photo-coagulation, superficial ablation with photo-coagulation, and photo-coagulation.

The flexible fiber and its handpiece make the CO_2 laser the soft tissue tool of choice for thousands of physicians, dentists and veterinarians worldwide.



LEFT: Figure 1. CO_2 Laser blepharoplasty in progress, photo courtesy of Edward M. Zimmerman, MD, Pres. ABLS, Las Vegas.



BELOW: Figure 2. CO_2 laser frenectomy in progress, photo courtesy of Alan Winner, DDS, New York.

The Learning Curve

The flexible fiber CO_2 laser is a soft-tissue scalpel that is easy and fun to get used to. The handpiece has easily interchangeable modalities for cutting, ablation and/or photo-coagulation; and there is an abundance of training and educational resources.

Figure 4a. Adjustable spot size tipless handpiece

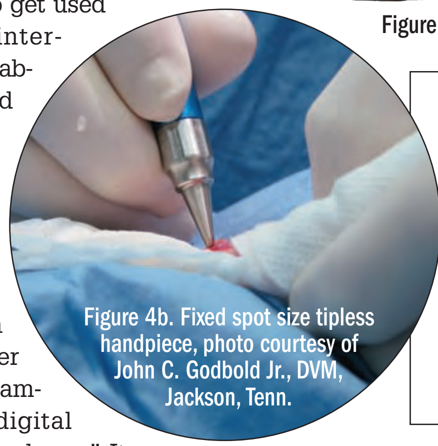


Figure 4b. Fixed spot size tipless handpiece, photo courtesy of John C. Godbold Jr., DVM, Jackson, Tenn.

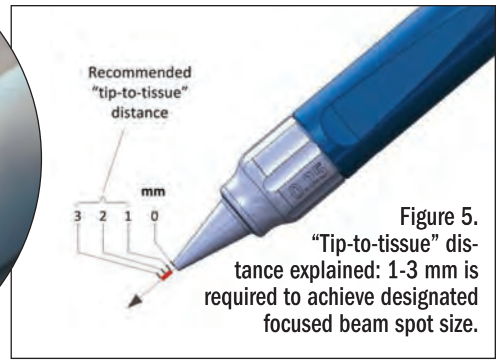


Figure 5. "Tip-to-tissue" distance explained: 1-3 mm is required to achieve designated focused beam spot size.

Educational resources: An extensive knowledge base of clinical case studies[1-7] has been developed to date, thanks to millions of surgeries performed with Luxar and Aesculight flexible fiber surgical CO_2 lasers. The prime example is[4] Dr. John C. Godbold's digital "Atlas of CO_2 Laser Surgery Procedures." It includes step-by-step slide shows and videos (with recommended power and beam settings) for the following popular veterinary surgical procedures:

Ano-Uro-Genital Procedures: Anal sac excision—closed technique; anal sac excision, open technique; cystotomy; cystotomy—transitional cell carcinoma ablation; feline perineal urethrostomy—traditional; feline perineal urethrostomy, modified; perianal adenoma; preputial stricture.

Elective Procedures: Canine neuter; feline declaw; feline neuter; ovariohysterectomy; tail dock and dewclaw removal.

Miscellaneous Soft-Tissue Procedures: Abscess incision and drainage; digital fibroma excision; enterotomy; liver biopsy; sebaceous cyst; toenail lasing; choledochotomy; elbow hygroma; lick granuloma; persistent right aortic arch; thyroidectomy.

Oral Procedures: acanthomatous epulis; gingivectomy; lingual plasmacytoma; oral mucosal hyperplasia; tissue sculpting; feline stomatitis; gingival hyperplasia; oral fibrosarcoma; sublingual sialocele.

Respiratory Procedures: laryngeal paralysis; nasal hyperkeratosis; soft palate resection; stenotic nares–feline; laryngeal saccule eversion; nasal planum resection; stenotic nares—canine; ventriculocordectomy.

Ear Procedures: aural hematoma; cerumen gland adenocarcinoma and ablation through MedRx Vetscope; ear canal polyp; ear crop.

Eye Procedures: cherry eye; entropion; feline squamous cell carcinoma eyelid; indolent ulcer; laser keratectomy; distichiasis; eyelid melanoma; feline squamous cell carcinoma, third eyelid; lacrimal punctotomy; meibomian gland adenoma.

Oncological Procedures: basal cell tumor ablation; histiocytoma; mammary lumpectomy; melanocytic nevus; tumor excision/ablation, ear cartilage; hemangioma; incisional biopsy; mastectomy; sebaceous hyperplasia, adenoma.

Orthopedic Procedures: dewclaw amputation; gerbil tail amputation; stifle imbrication, laser assisted; tail amputation; toe amputation.

Laser power density: Consider a steel blade; regardless of how sharp the blade is, there will be no interaction between the blade and the tissue unless mechanical pressure is applied to the blade, forcing it through the tissue surface. For a laser scalpel, the power density of the focused laser beam is equivalent to the mechanical pressure that is applied to a cold steel blade; the greater the laser power density, the greater the rate of soft tissue removal.

Laser handpiece: Disposable-free "tipless" veterinary handpieces are designed to closely simulate the scalpel experience without making any contact with the tissue. Maintaining 1-3 mm distance between the distal end of the handpiece and the tissue (**Figure 5**) is required to achieve the designated spot size (selected either by the spot size selector on the adjustable handpiece in **Figure 4a**, or by the appropriate nozzle for a fixed spot handpiece in **Figure 4b**).

Beam spot size for cutting: Just as the sharpness of the steel blade defines the quality and ease of the cut, the size of the laser beam focal spot defines the quality of the laser cut. The smaller (or sharper) the focal spot of the beam, the narrower and the deeper the incision.

Just as a dull blade cannot produce a quality incision, an oversized laser beam spot cannot produce a good quality incision. For Luxar's and Aesculight's older laser tips with older generation handpieces, the 0.4mm spot size is the most popular for cutting applications. For newer Aesculight tipless handpieces (**Figures 4a**

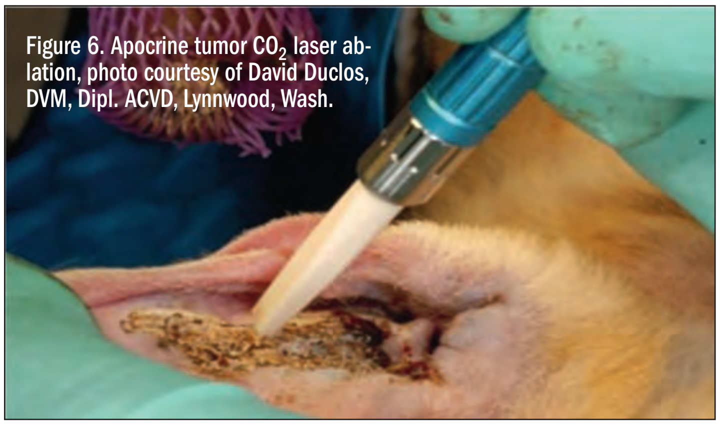


Figure 6. Apocrine tumor CO_2 laser ablation, photo courtesy of David Duclos, DVM, Dipl. ACVD, Lynnwood, Wash.

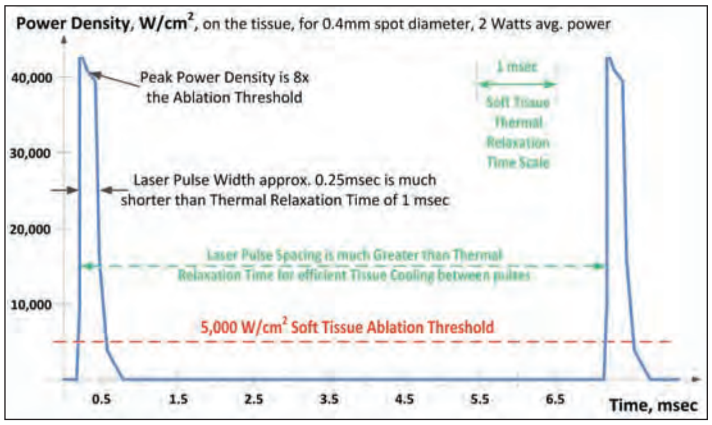


Figure 8. SuperPulse explained: High power, short laser pulses maximize soft tissue removal rate and keep adjacent tissue cool.

and 4b), the best spot size for cutting is 0.25mm.

For a rapid switch from cutting to just photo-coagulation, the laser beam can be defocused either by selecting a larger spot size, or by simply moving the handpiece away from the tissue by 10-15 mm or so, and "painting" the "bleeder" for enhanced hemostasis.

Beam spot size for superficial ablation: Not all surgical laser uses involve incising the tissue, as illustrated in **Figure 6** (apocrine tumor ablation).

Superficial surface ablation is best achieved through using large beam spot size settings, such as 0.8mm, 1.4mm diameter or 3mm x 0.4mm rectangle.

Hand-speed and incision/ablation depth control: For the most comfortable hand-speed control while achieving the desirable depth of incision or the rate of superficial ablation, the surgeon can vary the average laser power.

Just as a very gently applied small sharp blade is appropriate for thin avian skin incisions, the finest spot size of 0.25mm and low power settings would be recommended for a laser skin incision in birds.

For a thicker skin incision, a much higher power setting would be recommended while the spot size of 0.25mm would still be appropriate. However, when debulking a large tumor on a large animal, the larger 1.4mm spot size with up to 40 watts of laser power would be recommended for comfortable hand-speed and the most efficiency and expedient completion of the procedure.

Controlling thermal effects: The SuperPulse mode **(Figure 7)** is made of bursts of very high peak power laser pulses that are spaced far enough for efficient tissue cooling between the pulses. SuperPulse minimizes the amount of heat escaping from the cutting/ablation zone to surrounding tissue; it results in less char on the margins of the cut.

For a stronger hemostasis effect through photo-coagulation by laser light, turning the SuperPulse mode off is recommended.

Flexible fiber CO_2 laser surgery can be easily learned by any skilled veterinary surgeon. Advances in handpiece technology and fast return on investment make CO_2 laser surgery enjoyable and affordable as never before. ●

This Education Center story was underwritten by Aesculight of Woodinville, Wash.

Dr. Vitruk is founder and CEO of Aesculight LLC and Luxarcare LLC in Woodinville, Wash. and is a member of The Institute of Physics in London, U.K.

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The CO_2 laser-assisted no-gauze spay

By Masahiro Seki, DVM
For the Education Center

At our small animal clinic we perform multiple surgeries a day. Our routine usage of Aesculight surgical CO_2 laser allows for greatly simplified soft-tissue surgeries, such as femoral head osteotomy and enucleation surgery[1] and ovariohysterectomy (OHE) described in detail in this article.

Background

OHE is a fundamental abdominal surgery and is one of the most frequently performed soft tissue surgeries in veterinary practices today.

The main complications of OHE, traditionally performed with a steel scalpel and electrocautery, are postoperative pain, hemorrhage, swelling and infection[2]. At our clinic we perform all OHE procedures with a CO_2 surgical laser because this technique addresses all of the aforementioned complications.

Pets undergoing CO_2 laser-assisted OHE appear to feel less to no pain, and they recover and resume their usual activities faster than after the same procedure done with a scalpel and electrocautery.

Below is a step-by-step description of the "no-gauze" spay procedure performed with CO_2 laser on a young female cat. We refer to this procedure as no-gauze as there is no need to use gauze to manage bleeding, and we only use one or two moist gauzes as a backstop and for wiping off the "char."

'No-Gauze' Spay

▶ **Step 1: Initial skin incision.**

The skin is incised (Figure 1) with the CO_2 laser set to 20 watts in the Super Pulse mode (Figure 2) with 0.25mm focal spot size. High power Super Pulse (SP) is especially effective as it assures minimum thermal damage to adjacent tissues. High power SP mode permits a surgeon to move the laser handpiece much faster, which minimizes thermal necrosis.

▶ **Step 2: Subcutaneous tissue avulsion.**

After the skin is incised in high power SP mode, the

Figure 1

Figure 2

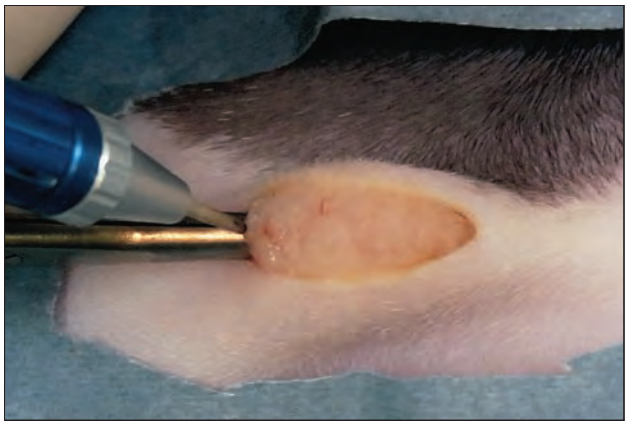

Figure 3

Figure 4

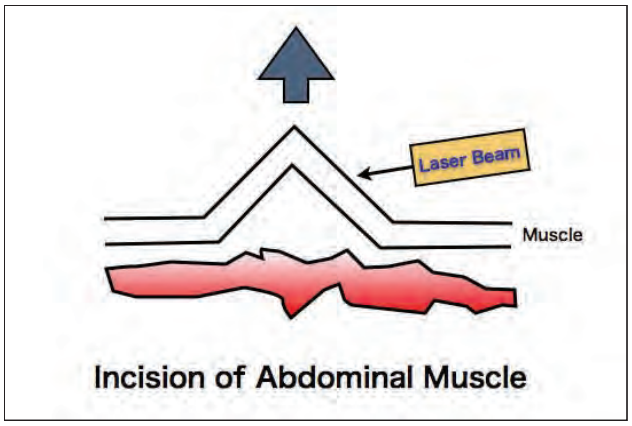

Figure 5

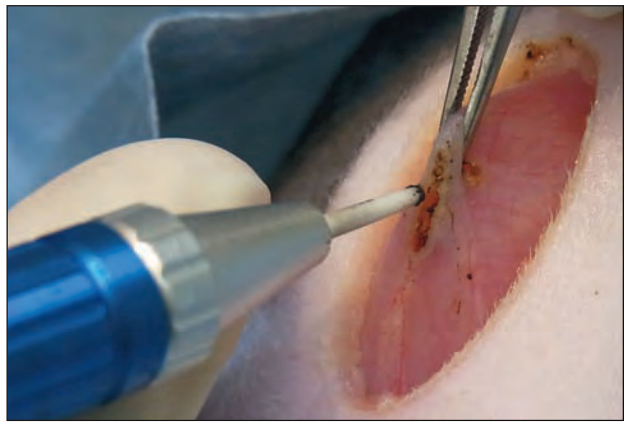

Figure 6

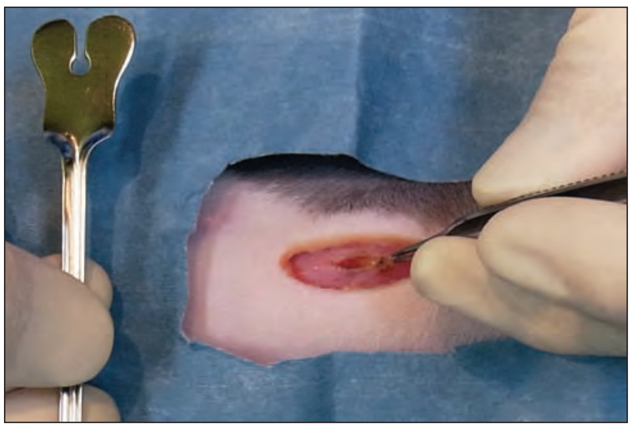

Figure 7

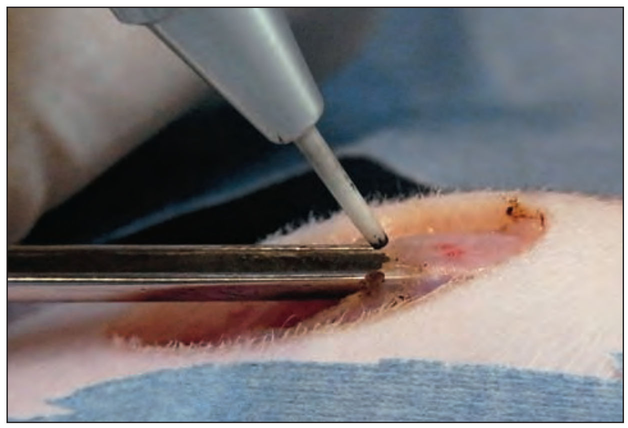

Figure 8

subcutaneous tissue is avulsed with Metzenbaum scissors; then the scissors are inserted under the subcutaneous tissue as a backstop and a laser incision is made (Figure 3), also with 0.25 mm spot size at 20 watts SuperPulse. Note the completely blood-free surgical field.

▶ **Step 3: Abdominal muscle incision.**

Linea alba is located and carefully picked up with forceps (Figure 4). The muscle tissue is pulled outward and laser beam is directed horizontally from the side so that the beam cannot pass through to the intraperitoneal organs (Figure 5) Then, a small hole is made through linea alba with 0.25mm spot size, using CO_2 laser setting 20W SP (Figure 6). Next, the winged groove director is inserted along peritonea, tension to membrane is applied and a laser cut is made (0.25mm spot size, 20W SP) (Figures 7 and 8).

▶ **Step 4: Cutting the suspensory ligament.**

The suspensory ligament is cut with a CO_2 laser after pulling the ovary out (Figure 9). The power setting of the laser is 8-10W CW, and the spot size is increased to 0.4-0.8 mm. The coagulation effect of the lower power density continuous wave (CW) mode on small blood vessels is more effective, and is recommended for the best hemostasis in highly vascular tissues. It is a much safer method with no bleeding, compared to the usual

Figure 9

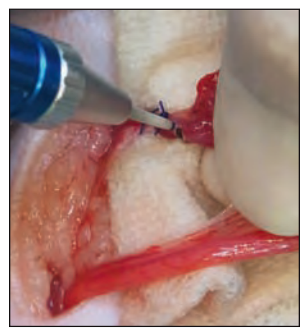

Figure 10

breaking of the ligament with the index finger.

▶ **Step 5: Ligation and cutting of the blood vessel.**

A figure-eight ligature is placed at the site. Then, using moistened gauze as a backstop, the blood vessel is cut with the laser beam (0.4-0.8 mm spot size, 8-10W CW) for coagulation (Figure 10).

▶ **Step 6: Cutting the broad ligament.**

The broad ligament is cut without ligation using 0.4-0.8mm spot size and the lower power setting of 6-8W CW. Note the complete lack of bleeding in the absence of ligatures (Figure 11).

▶ **Step 7: Do the other ovary the same way.**

▶ **Step 8: Cutting the uterine body.**

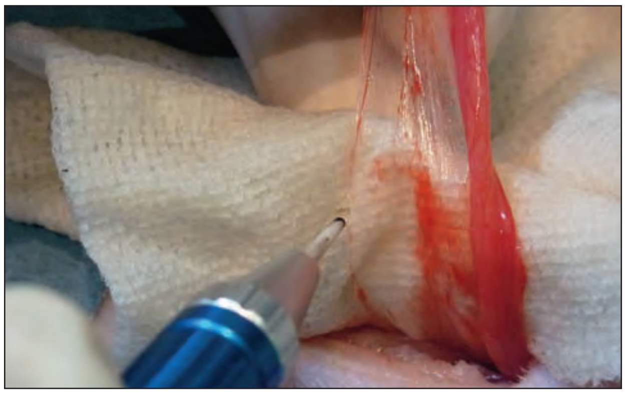
Figure 11

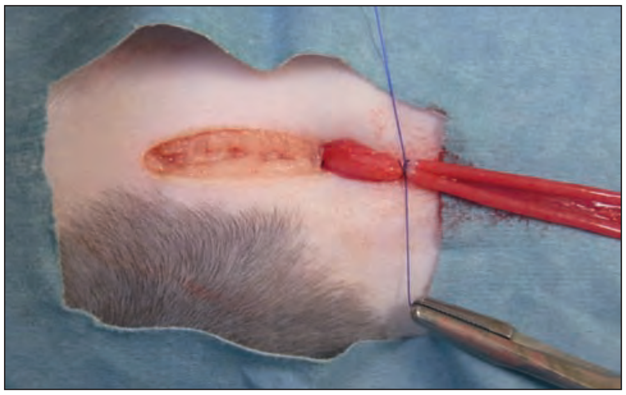
Figure 12

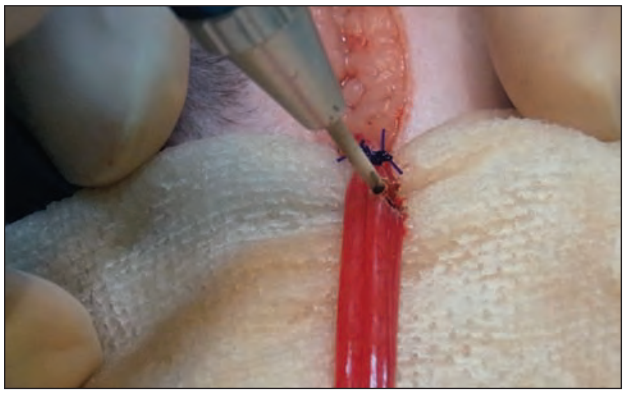
Figure 13

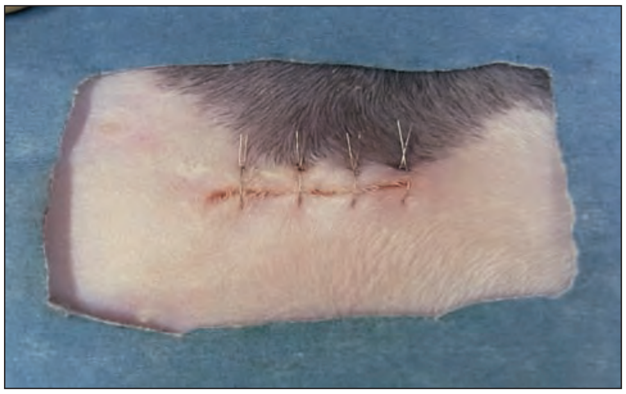
Figure 14

Ligation is done with a modified Miller's knot (Figure 12) and the uterine body is cut off using 0.4-0.8mm spot size and 8-10W CW setting of the CO_2 laser (Figure 13). Laser energy is applied to the uterine stump to contract and sterilize.

▶ **Step 9: Closure.**

The abdominal walls are closed and the skin is sutured (Figure 14); wiping skin margins with moist gauze sometimes is desirable if char traces are present. Stainless suture wire or skin stapler is used for suturing because they do not cause foreign body reaction and the animal doesn't want to lick the wound. Another advantage of suture wire is that it retains its oval loop shape which helps to avoid over-restriction of the skin. It makes the wound site heal beautifully.

Summary

A CO_2 laser assisted no-gauze spay is performed much faster than the conventional OHE procedure, and without the risk of post-operative complications and bleeding, allowing us to avoid post-surgery hospitalization. It is much appreciated by the pet owners and clinical personnel alike. ●

Dr. Masahiro Seki is the owner of a small animal clinic Animal Laser Center in Nagoya, Japan. He is the first board-certified veterinary laser surgeon in Japan. Dr. Seki is a diplomate of the American Board of Laser Surgery, and a director at the Japanese Laser Veterinary Science Society.

This Education Center story was underwritten by Aesculight of Woodinville, Wash.

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Laser removal of anal glands

By William E. Schultz, DVM
For The Education Center

Laser surgery has dramatically changed the visual surgical field by controlling hemorrhage without the tissue damage associated with electrosurgery and the enhanced visual field afforded the surgeon. Delicate dissection with visualization is a hallmark of laser surgery.

Anal gland removal is one surgery where the use of a laser dramatically decreases the bleeding and facilitates a rapid removal of the anal glands. In the case below, a flexible fiber waveguide CO_2 laser was used with the Aesculight adjustable tipless handpiece.

Anesthesia

We pre-medicate the patient with a mixture of torbutrol, atropine and Acepromazine. Induction is with Propofol 28 if over 25 pounds and if under 25 pounds, we will mask with Sevoflurane. Maintenance is with Sevoflurane. Either morphine or buprenorphine is used for pain control during the procedure. NSAID therapy is used postoperatively for four days. Dogs have very little discomfort postoperatively with this protocol.

Procedure Preparation

The dog is placed in a sternal recumbency with the tail elevated and the rear legs off the table. The use of a small beanbag or rolled towels to elevate the pelvis is helpful. The anal glands are then emptied as completely as possible. The anal glands are filled with dental impression material (Alginate) and the material is allowed to harden.

This material is flexible and is not hot when it hardens, lessening the chance of ancillary tissue damage outside of the anal glands. Alginate is a powder that is mixed with cold water and loaded in a catheter-tipped syringe or a syringe with a shortened tomcat catheter attached. The working time is 2 to 3 minutes after mixing.

The glands are filled until material is leaking out around the catheter **(Figure 1)**. Also, during surgery I wear a headlight and it is aimed away from the surgical field for the pictures, as the bright light may cause the camera to overexpose the surgical site. The material does not heat when it turns solid and effectively fills the gland for ease in dissection.

Visualization of the anal gland ducts before the Alginate is mixed is a good idea.

Initial Incisions

Skin incisions are made from about 3 o'clock to 5 o'clock on the right side and 9 o'clock to 7 o'clock on the left side of the perineum at the junction of the haired and non-haired tissues. The laser is set at 8 to 10 watts SuperPulse and 0.25 diameter spot size is used for these incisions.

After the skin is incised, blunt dissection is done to separate the external anal sphincter muscles **(Figure 2)**. Usually, with the incisions in the described location, the muscle is very thin and may be medial to the incision. The anal gland is visualized and blunt dissection is done to separate the gland from the surrounding tissues **(Figures 3 and 4)**.

In cases where the anal glands had previously ruptured or had severe infection, the dissection may be difficult. When scar tissue is thick, the laser may be turned to 3 to 4 watts SuperPulse for dissection, again with 0.25 diameter spot size. Gentle retraction of the fascia will allow the laser to dissect easily without damage to the anal gland.

During the blunt dissection the caudal and lateral aspects are usually easily done **(Figures 5 and 6)** but the cranial aspect is more difficult to reach. These areas are easily dissected using gentle caudal traction on the anal gland and the laser to separate the tissues (**Figures 7 and 8**). The duct is isolated and ligated close to the colon with 3-0 or 2-0 Monocryl, depending on the size of the dog **(Figure 9)**. The laser is used to cut the duct and remove the gland **(Figures 10 and 11)**.

It is very important in closure of the incisions that the sciatic nerve be spared. If the anal glands are very deep, the nerve may be visible, but in most cases the nerve is deep to the cranial aspect of the surgical field. Either 2-0 or 3-0 Monocryl is used in a loose vertical mattress pattern to close the wound **(Figure 12)**. Two to three sutures are placed and glue is used in the skin **(Figure 13)**. **Figure 14** demonstrates the removed anal sacs.

Post-Operative Instructions

If needed, an E-collar is used post op and in some cases diapers (Pull-Ups) may be used. With the laser, most dogs do not scoot or lick at the incision. We counsel owners to keep the dog on a leash for one week post-op and watch for any swelling or drainage.

In the rare case that the incision opens, it is treated as an open wound and allowed to granulate instead of placing new sutures. Granulex is an excellent product to increase the rate of second intention healing.


Figure 1


Figure 2

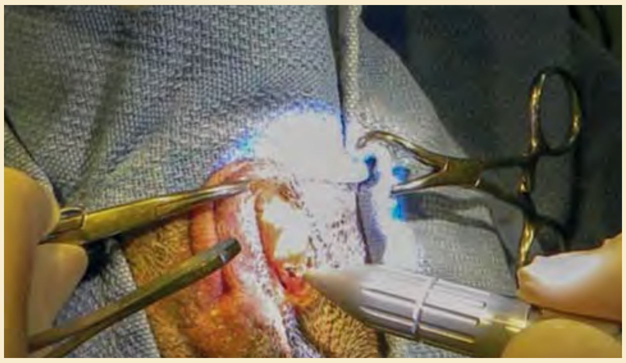
Figure 3


Figure 4


Figure 5


Figure 6


Figure 7


Figure 8


Figure 9

Figure 10

Figure 11

Figure 12

Summary

Note the lack of bleeding during the procedure. The ability to visualize the surgical field without hemorrhage and the enhanced dissection afforded by using a surgical laser speeds up the procedure and causes much less trauma to sensitive perineal tissues. ●

This Education Series story was underwritten by Aesculight Inc. of Woodinville, Wash., manufacturer of the only American-made CO_2 laser.

Figure 13

Figure 14

Dr. Will Schultz graduated from Michigan State University in 1973, went into private practice and opened his companion animal practice in the fall of 1974. Dr. Schultz has a special interest in canine reproduction and has been a board member on the Synbiotics Reproductive Advisory Panel, The Society for Theriogenology and The Theriogenology Foundation, with speaking engagements at several veterinary conferences, veterinary associations and national specialties He has lectured and published articles on transcervical and surgical inseminations using fresh, chilled and frozen semen. He also is interested in soft tissue and orthopedic surgery with laser surgery being an important modality for over 20 years. Dr. Schultz uses a 20-watt flexible waveguide CO_2 laser with constant and SuperPulse modes.

Introducing Veterinary CO_2 Laser Surgery in Japan

By Masahiro Seki, DVM, Dipl. of American Board of Laser Surgery For The Education Series

PHOTOS COURTESY OF DR. MASAHIRO SEKI

Figure 1

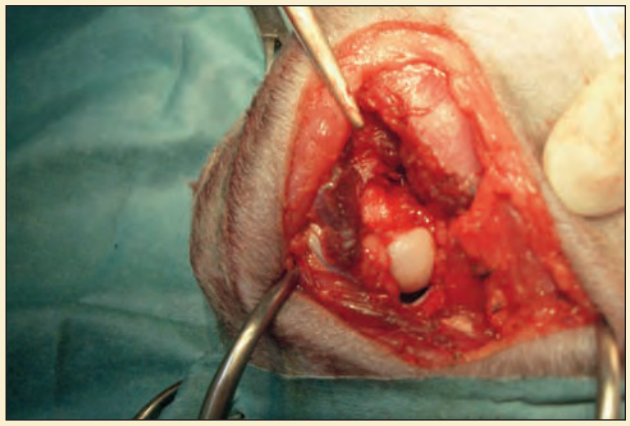

Figure 2

I am an owner of a busy small animal veterinary hospital in Nagoya, Japan. One day I encountered a book on CO_2 laser surgery and became fascinated with the technology that brings less bleeding, less swelling, less pain and less risk of infection. It goes without saying that less stress during and after surgical treatment is the best for humans and for animals.

I decided to learn more about small animal soft tissue laser surgery in the USA, and did so for two years at various private practices and at Louisiana State University. At the same time I studied to become a diplomate of the American Board of Laser Surgery (ABLS). Learning the art of laser surgery from the best veterinary laser surgeons in the U.S. and through ABLS allowed me to select the best surgical laser for my hospital back home.

Types of Medical Lasers

It is important to select the type of surgical laser by its wavelength and how it interacts with the tissue. Medical lasers can be assigned to one of three categories:

WYSIWYG stands for "What you see is what you get." This type is suitable for precise surgery with minimum thermal damage to adjacent tissue, because for those wavelengths the absorption coefficient is dominant over scattering coefficient in soft tissue. Examples are CO_2 at 10,600 nm and Er:YAG at 2,940 nm, but the CO_2 laser offers also a superior hemostasis over the Er:YAG laser.

WYDSCHY stands for "What you don't see can hurt you." For this type, the scattering of laser light inside the soft tissue is dominant over the absorption. As a result, the laser light spreads deep and wide inside the soft tissue, which can cause extensive and far-spread thermal necrosis at high power densities relevant to surgical applications.

WYDSCHY examples include Nd:YAG laser at 1,064 nm and laser diodes in the wavelength range of 800-1,000 nm intended for surgical use (i.e. not therapy). The safest way to use WYDSCHY laser surgically is not to use the laser light directly on the tissue, but only as a heat source to heat up the surgical tip (of glass fiber, either bare glass or sometimes with metal tip over the glass) in a "contact" mode where the heat (and not the laser light) interacts with the soft tissue.

SYCUTE stands for "Sometimes You Can Use Them Effectively." This type is useful for color-selective thermolytic destruction of pigmented tissue. Examples include Alexandrite laser at 755 nm and laser diodes in the wavelength range of 800-1,000 nm in highly successful human cosmetic applications where the laser light is used for hair removal (diodes) and skin pigmentation removal (Alexandrite).

Another SYCUTE example is laser therapy using 800-1,000 nm laser diodes at low power densities (i.e. not for surgery). These wavelengths exhibit low water absorption and have significant scattering in soft tissue allowing for deep and wide penetration of laser light. Another great application for laser diode is ICG-augmented diode laser treatment of leg veins–it only works with ICG pigment and is a perfect illustration of the SYCUTE concept.

Why CO_2 Laser?

A review of available surgical laser technologies reveals that the CO_2 laser at 10,600 nm wavelength is the most suitable for the soft tissue surgery. It is one of the simplest WYSIWYG lasers and it is not surprising that it is the most common surgical laser in human and veterinary medicine.

Ever since the invention of the CO_2 wavelength compatible flexible fiber (to be exact, this is a hollow reflective light guides made of metal with the interior surface highly polished and anti-reflective coated), the American made flexible fiber surgical CO_2 lasers became the lasers of choice for small office surgery around the globe. They bring simplicity and convenience to laser surgery unobtainable with older articulated arm lasers.

My choice was for flexible fiber CO_2 laser from Aesculight with its pioneering tipless laser handpiece that is used like a drawing pen during surgery. It features an on-board library of laser surgery cases, and is pre-programmed with useful pulsed and Super-Pulsed modes for ease of operation. It is rugged, durable and versatile, and has proven so far to be the right choice for our hospital.

CO_2 Laser Surgery Case Studies

I use my CO_2 laser for all surgeries at the hospital. There are some surgery cases that are hard to do without the CO_2 laser. Skin incisions illustrated in **Figure 1** are easy to perform with the tipless laser handpiece under the correct power and proper focal spot size settings of 0.25 mm, resulting in clean bloodless margins that heal easy and without complications.

The diode laser is not appropriate in this case as the skin gets damaged excessively due to slow thermal conduction of heat from the tip (glass or metal) to and through the soft tissue.

> A review of available surgical laser technologies reveals that the CO_2 Laser at 10,600 nm wavelength is the most suitable for the soft tissue surgery.

Figure 3A

Figure 3B

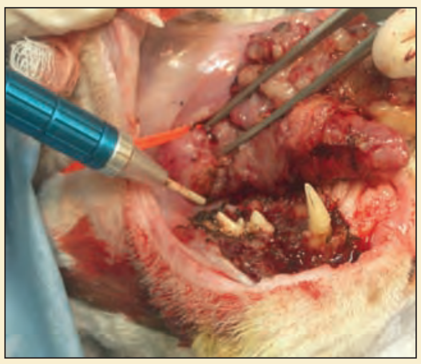

Figure 3C

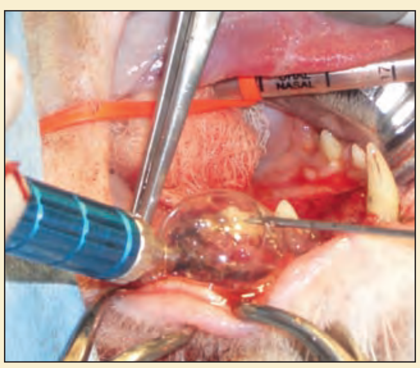

Figure 3D

Figure 3E

Figure 3F

Another great illustration of surgical CO_2 laser in action is femoral head osteotomy with much reduced intra-operative bleeding **(Figure 2)** that greatly simplifies the surgery.

For oral tumor **(Figures 3A and 3B)** palliative resection, I use the CO_2 laser to remove the tumor and to assist the maxillectomy while maintaining excellent hemostasis **(Figures 3C through 3E)**. For the CO_2 laser assisted maxillectomy, I use the cold saline flush to protect and facilitate cooling of the surrounding bone tissue. **Figure 3D** shows a bubble formed by laser beam striking a saline solution. **Figure 3E** illustrates dry, bloodless surgical site immediately after maxillectomy. A much improved patient is presented in immediate post-op image in **Figure 3F**.

Enucleation is much simplified if performed with a CO_2 laser. All stages of the procedure are literally blood-free: conjunctiva incision **(Figure 4A)**, eye muscle resection **(Figure 4B)**, removal of the eyeball **(Figures 4C and 4D)** and eyelid resection **(Figure 4E)**. A great outcome is presented in the immediate post-op image in Figure 4F.

Summary

My experience with CO_2 laser for surgery at our hospital is in sync with how laser surgery is practiced in North America. It is a new and pioneering concept, however, in Japan, where until now laser diodes were promoted for soft tissue surgery. Hopefully more laser veterinarians from Japan can get trained at the American Board of Laser Surgery in the advantages of CO_2 laser wavelength for soft tissue surgery—and for the benefit of our patients. ●

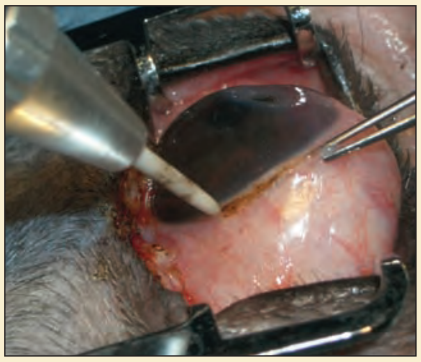
Figure 4A


Figure 4B


Figure 4C

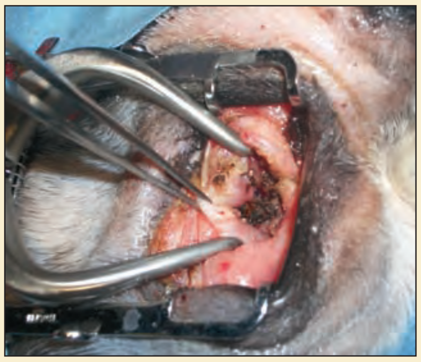
Figure 4D


Figure 4E


Figure 4F

Dr. Masahiro Seki is the owner of a small animal clinic Animal Laser Center in Nagoya, Japan. He is the first board certified veterinary laser surgeon in Japan. He uses both the CO_2 and diode laser wavelengths in his practice. Dr. Seki is a diplomate of American Board of Laser Surgery, and a director at the Japanese Laser Veterinary Science Society.

This Education Series article was underwritten by Aesculight LLC of Woodinville, Wash., manufacturer of the only American-made CO_2 laser.

CO_2 laser-assisted management of feline stomatitis after extractions

By Jan Bellows, DVM, Dipl. ACVD, Dipl. ABVP, and Elizabeth McMorran, DrMedVet
For The Education Center

Laser ablation can provide long-term caudal stomatitis cure.

Stomatitis is an inflammation of the mucous lining of any of the structures in the mouth; in clinical use the term should be reserved to describe widespread oral inflammation (beyond gingivitis and periodontitis) that may also extend into submucosal tissues (e.g., marked caudal mucositis extending into submucosal tissues may be termed caudal stomatitis).

Feline caudal stomatitis represents a growing and frustrating problem in veterinary oral care. The etiology of stomatitis is still unknown, although a multifactorial hyperimmune response to plaque is felt to be involved. This has led to many therapeutic approaches with varying success.

Surgical laser ablation has provided long-term control of the inflammation in a number of our adult feline patients with persistent caudal stomatitis despite extractions.

CASE 1: Initial findings

Signalment: Colby, 3-year-old neutered male domestic shorthair

Presenting complaint: Painful mouth, drops food while eating, hasn't groomed recently

Medications: Repositol steroid therapy in the past without long-term control of symptoms and subsequent weight gain

Oral examination findings: Inflamed buccal, gingival and alveolar mucosa, permanent dentition is present

Diagnosis: Feline stomatitis based on clinical appearance

Treatment plan: Surgical extraction of all teeth followed by three monthly laser ablation sessions of his oral mucosa using the Aesculight CO_2 laser set at 2 watts in continuous mode using a wide ceramic tip

Outcome: Recovery following extractions was uneventful. Laser ablation of inflamed areas was done three times following initial visit **(Figures 1a and 1b)**. Twelve weeks after extracting the teeth, the inflamed alveolar mucosa was minimal. Patient has been comfortable with no recurrence of stomatitis lesions for one year **(Figure 1c)**.

CASE 2: Initial findings

Signalment: Toasty, 17-month-old domestic shorthair; FIV/FeLV negative

Presenting complaint: Bleeding and swollen gingiva, inappetence

Medications: None at initial presentation although a repositol steroid injection and antimicrobials had been administered five and three months prior to presentation

Oral examination findings: Inflamed buccal, gingival and alveolar mucosa, complicated fractured right mandibular incisor (401) **(Figure 2a)**.

Diagnosis: Feline stomatitis and fractured incisor based on clinical appearance and radiographs

Treatment plan: Surgical extraction of all buccal teeth and right mandibular first incisor followed by immediate laser ablation of caudal stomatitis inflammation using the CO_2 laser set at 2 watts in continuous mode using a wide ceramic tip **(Figure 2b)**.

Outcome: Recovery following extractions was uneventful. Laser ablation of oral mucosa using the CO_2 laser set at 2 watts in continuous mode using a wide ceramic tip was repeated four weeks following oral surgery and initial laser treatment. A third ablation was performed eight weeks after the initial visit using the CO_2 laser's 0.8 mm ceramic tip to ablate exact areas of residual inflammation. Patient has been comfortable with no recurrence of stomatitis lesions for five months. **Figure 2c** presents four-month post-op view of the patient.

CASE 3: Initial findings

Signalment: Cookie, 3-year-old spayed female domestic shorthair; FIV positive

Presenting complaint: Inappetence, halitosis and advanced periodontal disease

Medications: None at initial presentation

Oral examination findings: Inflamed buccal, gingival and alveolar mucosa, tooth resorption affecting multiple premolars and molars

Diagnosis: Advanced periodontal disease, stomatitis, and tooth resorption (TR3 and TR4) affecting 207, 208, 307, 308, 309, 407, 408 and 409 based on clinical probing and intraoral radiographs

Treatment plan: Surgical extraction of all remaining teeth—see **Figure 3a**.

Outcome: Recovery following extractions was uneventful. Surgical ablation of oral mucosa using a non-SuperPulse setting at 6 watts in continuous mode using a 0.8 mm ceramic tip was performed eight and 12 weeks following oral surgery **(Figures 3b and 3c)**. Patient has been comfortable with no recurrence of stomatitis lesions for five years **(Figure 3d)**.

Discussion

Feline stomatitis treatment goals include reducing the inflammatory response to dental plaque. Constant administration of anti-inflammatory and steroid medication has not been shown to be curative or indicated and may result in patient harm.

Extraction of all teeth caudal to the canines or, in other cases where the canines or incisors are not clinically normal, extraction of all the teeth results in improvement of 80 percent of treated cats; 60 percent of these cats are cured and do not require additional therapy, while 20 percent may still show signs of oral inflammation, but do not appear to have oral pain.

The remaining 20 percent that did not respond after extracting all of the teeth require additional care.

This additional care may include interferon therapy. Although it is frequently used in Europe, the product

CASE 1

FIGURE 1A: Four weeks after extracting all teeth, the sites have healed; oral inflammation treated with the Aesculight CO_2 laser.

FIGURE 1B: Eight weeks after extractions, relaser ablation of the inflamed areas.

FIGURE 1C: Twelve weeks after presentation, inflammation is minimal and patient is comfortable.

CASE 2

FIGURE 2A: Bleeding and redness of the buccal mucosa on presentation.

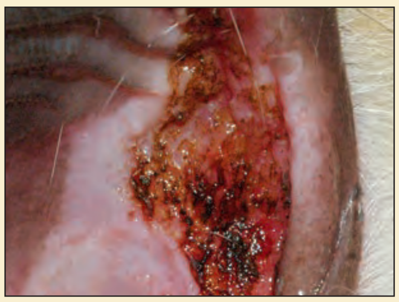

FIGURE 2B: Immediately after first laser ablation treatment, excessive char removed

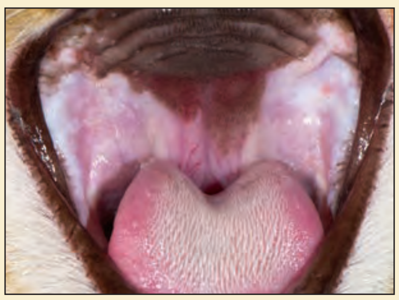

FIGURE 2C: Four months after presentation and three laser treatments, oral mucosa is healthy and patient is comfortable.

CASE 3

FIGURE 3A: Eight weeks after initial presentation and oral surgery.

FIGURE 3B: After first laser ablation.

FIGURE 3C: Oral mucosa 12 weeks after initial visit, four weeks after first laser ablation.

FIGURE 3D: Five years after oral surgery and laser treatment, patient is comfortable and oral mucosa is healthy.

This Education Center article was underwritten by Aesculight of Woodinville, Wash., manufacturer of the only American-made CO_2 laser.

FIGURE 4: Stomatitis treatment with CO_2 laser.

is not widely available in the U.S. and its efficacy has not been proven. As it must be administered orally, patient acceptance can be limited in moderate to severe cases due to oral discomfort.

Removal of the inflamed tissues and preventing recurrence are surgical goals. Great care should be taken after extracting the teeth to preserve healthy mucosa and tension-free mucosal flaps sutured in place over the extractions sites, providing optimal healing.

Areas affected by oropharyngeal inflammation in the most caudal regions of the mouth do not have teeth. Logistically, cutting or scraping the tissue is difficult, resulting in trauma of adjacent tissue, along with incomplete removal or resection of the inflamed mucosa. A carbon dioxide laser allows the practitioner to moderately ablate inflamed areas without touching them with the laser's tip. Aesculight's flexible fiber CO_2 laser handpiece can be held like a pen, focusing the laser's energy on the exact areas requiring treatment—see **Figure 4.**

The CO_2 laser emits a coherent, collimated, monochromatic beam of invisible light—wavelength 10.6 µm with a lot of energy focused on a small spot. This beam is rapidly absorbed by the water present in tissues with little scatter—average ablated zones of 100-300 microns at the edges of treated tissues are typical. The energy absorbed by the treated tissues causes water evaporation and cell lysis. Nerve endings are vaporized; blood and lymphatic vessels sealed. By using a variety of laser tips and adjusting the energy settings, a CO_2 laser can be used to provide enough energy to ablate or remove inflamed oral tissues throughout the mouth and promote healing by second intention and fibrosis.

Many patients seen in our practice and also those feline stomatitis patients described in the veterinary dental literature require more than full-mouth extractions. These cats need relief that long-term systemic antibiotics and steroids cannot provide. Laser ablation helps remove the inflamed mucosa, reduces pain and stimulates healing within the mouth in one treatment session. Tissue regeneration and fibrosis is stimulated and healthy mucosa can develop, replacing the inflamed tissues.

Short anesthetic episodes are required to ablate inflamed regions in the mouth. Using the CO_2 laser in these refractory cases can lead to long-term control and most often resolution of the inflammation. We treat every four weeks for a maximum of three months until the noticeable inflammation in the caudal areas of their mouths has diminished. This is usually achieved after two or three treatments. Monthly monitoring through oral health examinations confirms resolution. In cases that do not fully resolve, all teeth are extracted followed by monthly laser ablation. ●

RECOMMENDED READING...

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Lewis JR, Tsugawa AJ, Reiter AM. Use of CO2 Laser as an adjunctive treatment for caudal stomatitis in a cat. J Vet Dent 24:240-249, 2007.

Dr. Bellows was certified by the Board of Veterinary Practitioners (canine and feline) in 1986 and by the College of Veterinary Dentistry in 1990. Currently he is president of the American Veterinary Dental College (2013-14).

Elizabeth McMorran earned her veterinary degree at the Ludwig Maximilians University of Munich and is completing the residency requirements for the American Veterinary Dental College. Together with her mentor, Dr. Bellows, she practices medicine at All Pets Dental in Weston, Fla.

CO_2 laser allows bloodless repair of stenotic nares

By Daniel M. Core, DVM
For The Education Center

Our hospital has used CO_2 laser surgery in place of conventional cold steel procedures since 1999. CO_2 lasers offer the veterinary surgeon the advantages of a precise surgical incision, reduced hemorrhage, pain and swelling, and minimal collateral damage.

CO_2 laser surgery not only allows the veterinary surgeon increased proficiency in commonly performed procedures, but also enables him or her to do laser-specific procedures that were formerly referred out to specialists.

Stenotic nares are a common problem in brachycephalic breeds of dogs and cats. It is a congenital malformation of the nasal cartilage **(Figure 1)**. Stenotic nares, along with elongated soft palate and everted laryngeal saccules, are components of brachycephalic obstructive airway syndrome (BOAS).

Patients with stenotic nares have nasal cartilage that lacks normal rigidity and collapses during inspiration, occluding the nares. The reduction in nasal airflow leads to greater inspiratory effort. The resulting dyspnea exacerbates elongated soft palate in affected individuals and can cause clinical BOAS.

Early recognition and surgical correction of stenotic nares, performed as early as 3 to 4 months of age, may decrease the severity of and possibly eliminate clinical BOAS.

CO_2 Laser Surgery

The concept of stenotic nares surgery is based on the physics of airflow through the nasal passages. As the diameter of an airway increases, the flow rate increases proportionally to the cross sectional area of the airway. In other words, an increase in airway facilitates flow rate and results in diminished respiratory effort.

Conventional cold steel surgical repair of stenotic airways can be difficult due to hemorrhage. Due to obstructed view, the surgeon must be especially careful to excise equal size tissue segments on both sides and create symmetry. Cold steel procedure requires three to four sutures on both sides to reappose the tissues [1, p.834]. The procedure may leave scars (ibid.).

CO_2 laser surgical repair of stenotic nares is bloodless, which provides clear view of the surgical field, thus allowing for precise surgical incision. The flexible fiber waveguide of our Aesculight CO_2 laser is light-weight, easy to maneuver and thus ensures a better incision control. This laser procedure does not require suturing, brings an excellent aesthetic result, and leaves patients discomfort-free post-operatively [2]. The good time to perform CO_2 laser stenotic nares correction is during a routine castration or ovariectomy without a significant increase in anesthesia time.

Anesthesia

General anesthesia is administered. Since patients with upper respiratory disease present significant anesthetic risks, special caution should be taken during sedation and intubation. For general anesthetic recommendations and selected anesthetic protocols see [1, pp. 818 and 833].

Positioning

The patient is positioned in sternal recumbency with the chin elevated. The planum nasale is scrubbed with antiseptic[1].

CO_2 Laser Settings

Incision marking: 2 watts in the continuous wave SuperPulse mode with a 0.25 mm-0.4 mm spot size **(Figure 2a)**.

Excision of redundant tissue: 6-10 watts in the continuous wave SuperPulse mode with a 0.25 mm-0.4 mm spot size **(Figure 2b)**.

Initial Incision

The proposed incision is marked with the laser at a very low setting **(Figures 2a and 3-5)**.

Tissue Removal

A moistened Q-tip is inserted in the nares and serves as a back stop **(Figure 6)**.

A dorso-lateral incision of the alar cartilage is preformed, while forceps are used to provide ventromedial traction. **Note**: Excision of the alar cartilage is strongly preferred to ablation, as it helps to prevent post-operative stricture.

The incision is continued proximally, which results in the removal of a cone or triangular section of tissue **(Figure 6)**.

Repeat steps 1-3 on the contralateral side **(Figure 7)**.

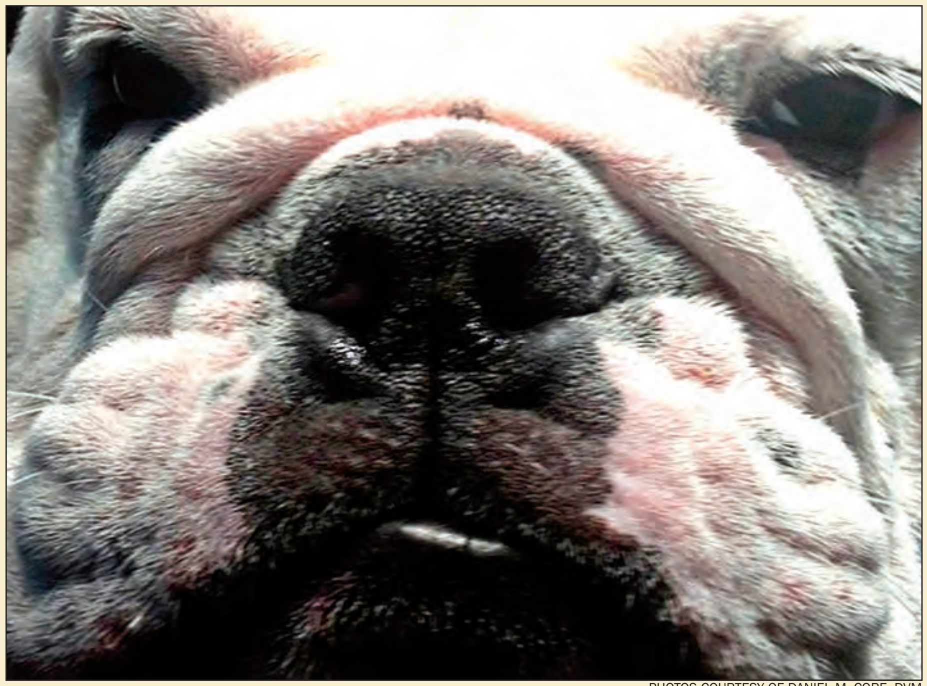
No suturing is necessary **(Figure 8)**.

Post-Operative Instructions

Post-operative care is minimal and patients are discharged on the same day. If the tissue in the surgical site becomes overly dry, apply antibiotic ointment.

Summary

Stenotic nares are a key component of brachycephalic obstructive airway syndrome. Elective surgical intervention at an early age can minimize and sometimes completely eliminate clinical signs of BOAS. CO_2 laser surgical correction of stenotic nares is simple and easy and yields a very gratifying cosmetic result. This procedure can be conveniently combined with a routine ovariectomy or castration without a significant increase in anesthesia time. ●



PHOTOS COURTESY OF DANIEL M. CORE, DVM

FIGURE 1: Pre-operative view

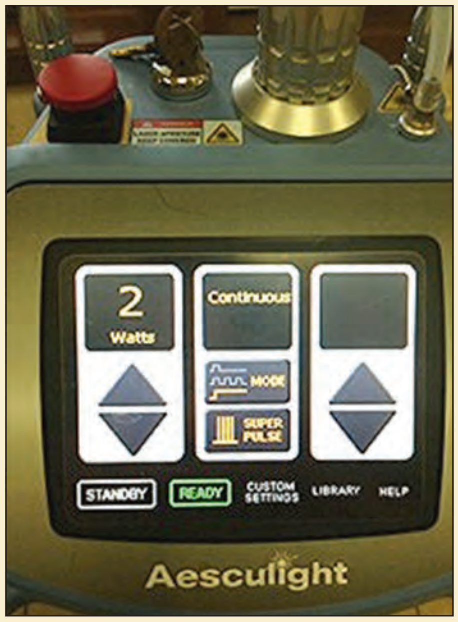


FIGURE 2A

FIGURE 2B

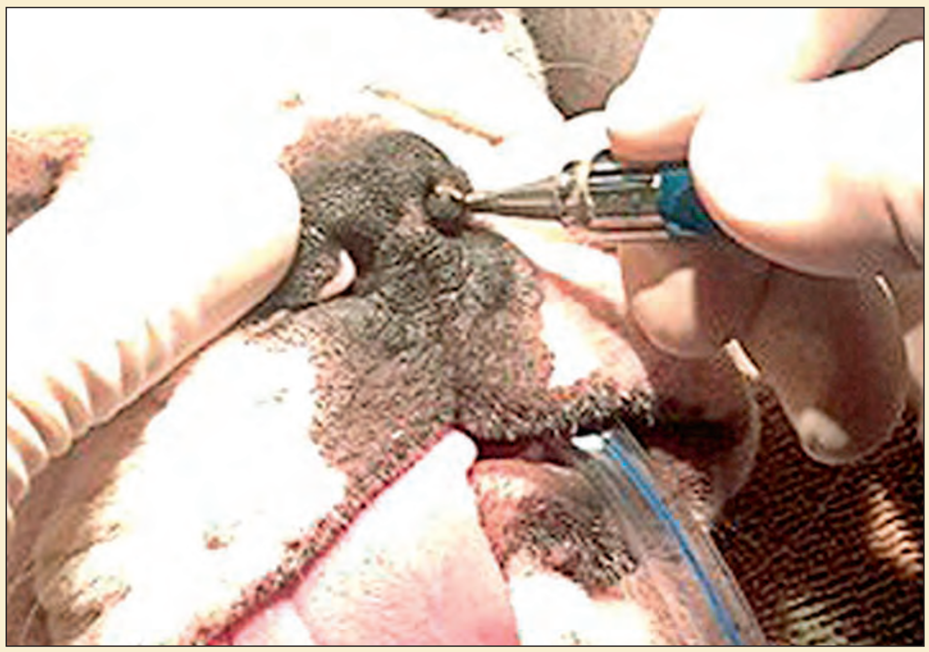


FIGURE 3. Laser marking prior to incision—left side.

Daniel Core, DVM, is a small animal practitioner and owner of Airline Animal Health and Surgical Center in Bossier City, La. He graduated from Louisiana State University School of Veterinary Medicine in 1981 and completed a small animal internship at Auburn University School of Veterinary Medicine in 1982. He has lectured on CO_2 laser surgery and therapy lasers. He is currently using his third CO_2 laser.

Symmetrical laser marking prior to incision—right side.

FIGURE 4

Aesculight 0.4 mm laser handpiece.

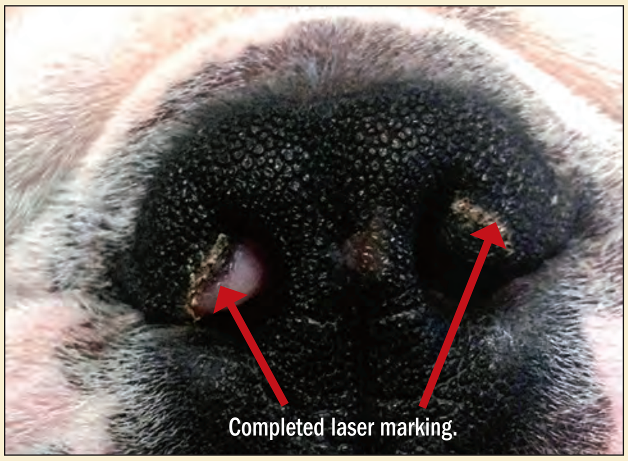


FIGURE 5

FIGURE 6. Excised wedge of alar cartilage—left side.

FIGURE 7. Excision repeated on the contralateral side.

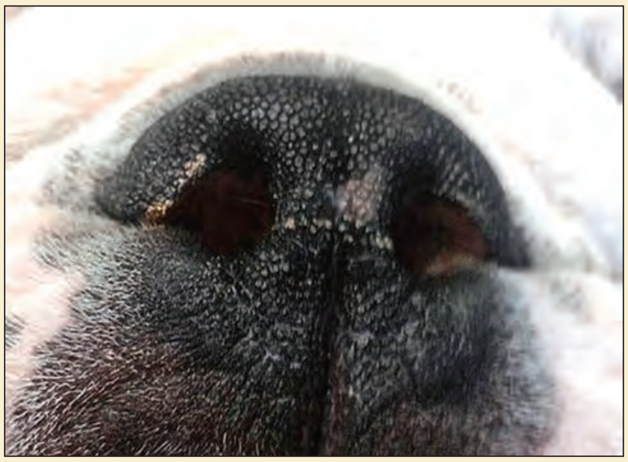


FIGURE 8. Immediate port-operative view. No suturing is necessary.

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This Education Center story was underwritten by Aesculight LLC of Woodinville, Wash., manufacturer of the only American-made CO_2 surgical laser.

CO_2 laser–assisted castration

By William E. Schultz, DVM, For The Education Center

This article describes a CO_2 laser-assisted canine castration procedure. The use of a CO_2 laser and an incision location not normally used for the surgery allow for a bloodless castration with reduced risk of scrotal hematoma, scrotal bruising or infection (in comparison with the conventional scalpel procedure described in Small Animal Surgery [1]) and results in a very small postoperative wound.

Anesthesia

The dog is premedicated with acepromazine/atropine/torbutrol with a preoperative chemistry panel being done while the preanesthetic is taking effect. Dogs less than 10 kg are masked with Sevoflurane and dogs larger than 10 kg are induced with Propofol 28 and then maintained on Sevoflurane for the procedure. When under anesthesia, an injection of morphine is given.

Preparation for Surgery

The dog is placed in dorsal recumbency using a V-trough or chest positioner. The scrotum is shaved and a surgical prep with chloroxylenol is used to prepare the scrotum for surgery **(Figure 1)**.

Surgical Laser

The high absorption rate of 10.6 µm wavelength of the CO_2 laser in water makes it the best practical laser for soft tissue surgeries. The minimal collateral thermal effects of the CO_2 laser are sufficient for sealing blood vessels, lymphatics and nerve endings. The high intensity of the laser beam destroys surface pathogens on incision/ablation margins, producing a sanitizing effect.

The laser tip does not touch the tissue, thus further lowering the risk of infection. Aesculight flexible fiber and its scalpel-like tipless handpiece **(Figure 2)** make the CO_2 laser a highly ergonomic and efficient tool for our everyday surgeries such as the canine castration presented here.

Step 1: Initial Incision

The scrotum is draped and the tipless laser handpiece H-FF with a .25mm diameter focal spot size is used with SuperPulse laser settings at 10 watts **(Figure 2)**. The scrotum is held with light pressure on the testicle to stretch the tissues and an incision with 0.25mm size laser beam is made on the ventral midline of the scrotum **(Figure 3)**.

The incision is continued through the skin and not through the vaginal tunic **(Figure 4)**. I prefer to do a closed technique but the vaginal tunic may be opened if an open castration is preferred.

Step 2: Removal of Testicles

The testicle is removed from the scrotum and the spermatic cord is gently cleaned of fat and connective tissue with a gauze sponge. The second testicle is pressed to the incision with a laser and the fascia is opened to the level of the vaginal tunic **(Figure 5)**. The second testicle is also exteriorized, elevated and the spermatic cord is cleaned of fat and connective tissues **(Figures 6 and 7)**.

Step 3: Cord Ligation and Wound Closure

Small dogs will have the spermatic cords ligated with 3-0 Monocryl and larger dogs will be ligated with either 2-0 or 0-Monocryl **(Figure 8)**. The cord is double clamped with mosquito hemostats and the cord is cut between the hemostats with scissors or laser **(Figures 9-11)**.

When the laser is used to transect the cords, a saline sponge should be used as a backstop. The hemostat is removed from the cords and they are observed for hemorrhage **(Figure 12)** and then released. *If hemorrhage is noted in the scrotal incision, defocus the laser beam by moving the hand away from the tissue and paint along the bleeding vessel to achieve hemostasis.

The scrotal incision is then closed with a continuous subcuticular pattern using the remaining Monocryl **(Figure 13)**. No skin sutures are used. Within minutes of the closure the scrotal tissues shrink, resulting in an effectively smaller surgical incision **(Figure 14)**.

Because the incision is made in the scrotum, and because the scrotum shrinks dramatically postoperatively, there are very few postoperative complications and licking is extremely rare.

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1. Hedlund CS. Surgery of the Reproductive and Genital Systems. In: Fossum TW (Ed). Small Animal Surgery, 3rd ed, St. Luis, MO: Elsevier/Mosby, 2007; 702–774.

This Education Center story was underwritten by Aesculight Inc. of Woodinville, Wash., manufacturer of the only American-made CO_2 laser.

Figure 1

Figure 2

Figure 3

Figure 4

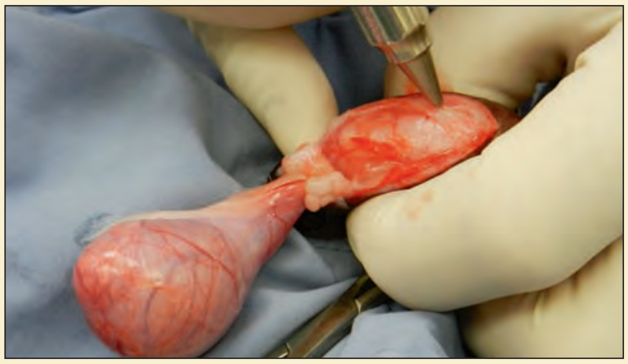


Figure 5

Figure 6

Figure 7

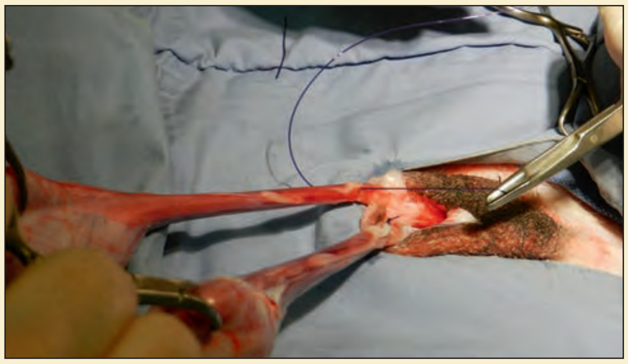


Figure 8

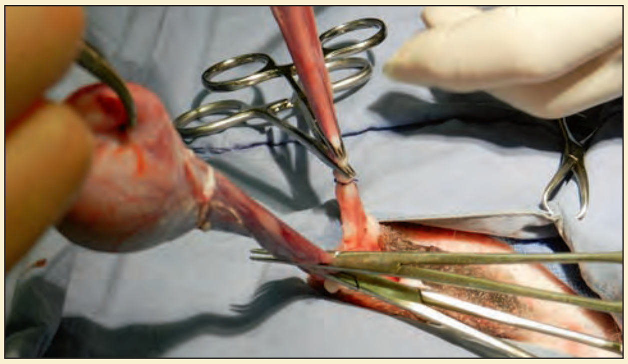


Figure 9

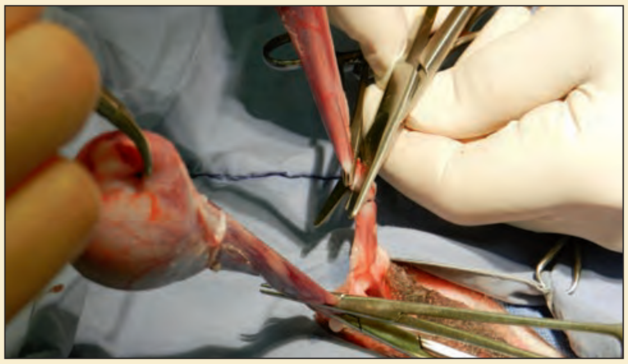


Figure 10

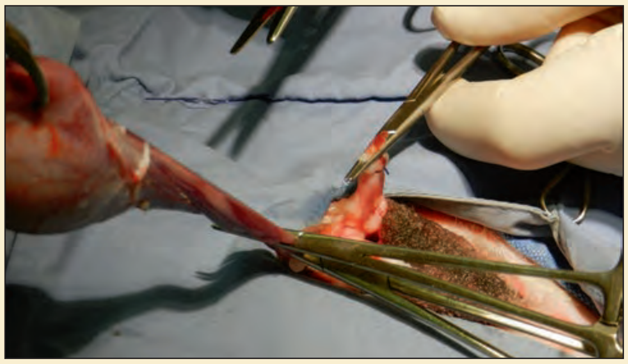


Figure 11

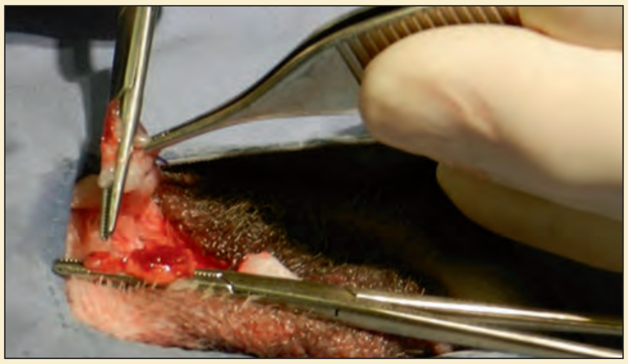


Figure 12

Postoperative Care

A canine NSAID is given for four days postoperatively and the dog is confined to leash-only behavior for five to seven days.

Conclusion

The surgical CO_2 laser allows for an almost completely bloodless surgical castration procedure with a rapid and uneventful recovery. Flexible fiber CO2 laser surgery can be easily learned by a skilled veterinary surgeon. Advances in beam delivery and handpiece technology make CO_2 laser surgery enjoyable as never before. ●

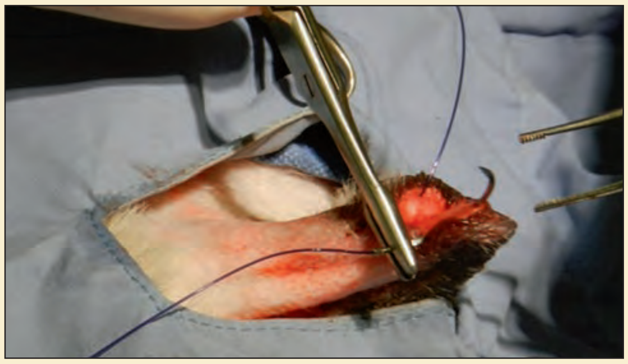


Figure 13


Figure 14

Dr. Will Schultz graduated from Michigan State University in 1973, went into private practice and opened his companion animal practice in the fall of 1974. He has been a board member on the Synbiotics Reproductive Advisory Panel, The Society for Theriogenology and The Theriogenology Foundation with speaking engagements at several veterinary conferences, veterinary associations and national specialties because of a special interest in canine reproduction. Dr. Schultz has lectured and published articles on transcervical and surgical inseminations using fresh, chilled and frozen semen. Soft tissue and orthopedic surgery are also areas of special interest with laser surgery being an important modality for over 20 years. Currently Dr. Schultz is using a 20-watt flexible waveguide CO_2 laser with constant and SuperPulse modes.

Vulvoplasty using the CO_2 laser

By William E. Schultz, DVM
For The Education Center

Redundant vulvar fold is a common problem in the bitch and is a cause for recurrent urinary tract infections.

The presence of a vulvar fold should always be considered with frequent UTI, house training issues, tenesmus, frequent urination and licking or attention to the perineal area.

A fold of skin that partially or completely covers the external vulva is characteristic of a redundant fold. During micturition the bitch will splash urine on the fold and the perivulvar area will become irritated and, in some cases, ulceration due to chronic infection will be present.

Laser-assisted Surgery

Surgical intervention is necessary when medical therapy fails to control the problems associated with redundant vulvar fold. Surgical removal of the tissue is curative.

Using steel for the procedure results in moderate to severe hemorrhage with poor visualization of the surgical field. CO_2 laser surgery is very clean and the lack of friction during the skin incision allows for accurate incision placement.

Flexible fiber waveguide CO_2 laser facilitates surgery even more by giving the surgeon freedom of movement without fatiguing the arm and hand.

Procedure Preparation

The bitch is placed in ventral recumbency with a pad or beanbag supporting the pelvis. The tail is tied vertically and the site is prepped according to standard procedure **(Figures 1 and 2)**.

Anesthesia

We premedicate with a combination of acepromazine, atropine and Torbutrol; induction is with Propofol; and maintenance is with Sevoflurane. Morphine is given during the procedure and the bitch is sent home on a veterinary NSAID for four to five days.


Figure 1


Figure 2


Figure 3


Figure 4

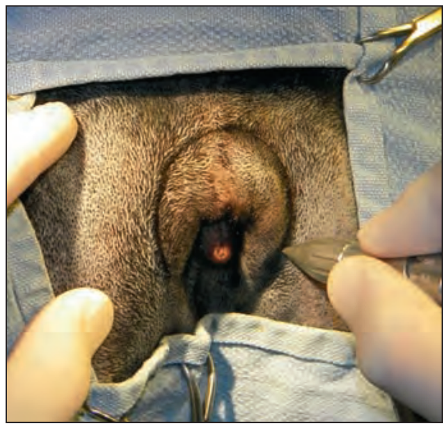


Figure 5


Figure 6


Figure 7

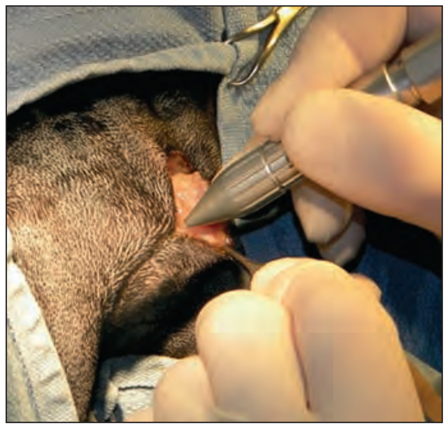


Figure 8

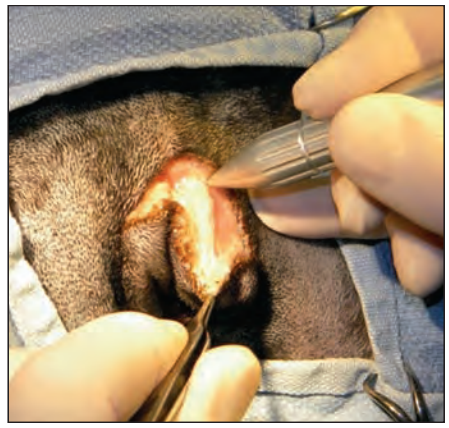


Figure 9


Figure 10


Figure 11


Figure 12

CO_2 Laser Sttings

The laser is set at 10 watts superpulse and a 0.25 mm tip is used. We have used both the adjustable and fixed-spot Aesculight handpiece for this procedure and both work exceptionally well. In this case, the adjustable tipless handpiece was used **(Figure 3)**.

Initial Incision

An incision is made in the perivulvar space just lateral to the existing dermatitis that surrounds the vulva **(Figure 4)**. This is to allow suture placement in healthy tissue.

The incision extends laterally and ventrally to the ventral aspect of the vulva and will include the lateral fatty tissue **(Figure 5)**.

Excess Skin Removal

The second incision is made dorsally and approximates the close perivulvar incision **(Figures 6 and 7)**.

Initially the fold may be raised with forceps to determine the width of the second incision. When the incision is made, the perivulvar tissue should be lifted dorsally to be sure sufficient tissue is removed to give full exposure to the vulva post op **(Figures 8, 9, 10 and 11)**.

When the skin is removed, the underlying fat is removed either by laser ablation or by lifting with forceps and cutting with the laser **(Figure 12)**. The laser is on constant lase at 15 to 20 watts for this portion of the procedure.

Wound Closure

2-0 Monocryl is used for closure. Intermittent sub-

Figure 13

Figure 14

Figure 15

cuticular sutures are placed with the initial sutures at 12 o'clock, 3 o'clock and 9 o'clock **(Figures 13 and 14)**. This allows for proper apposition of the tissues.

The inner incision is much smaller than the outer incision and proper alignment is easily accomplished with this method. Skin closure is also done with 2-0 Monocryl using either a cruciate or simple interrupted pattern **(Figure 15)**.

Post-operative Instructions

A restraint collar is placed immediately post-op to prevent chewing and licking at the surgical site; it remains on the bitch until suture removal at two weeks post-op.

Owners are instructed to keep her on a leash with no free running the first week. Antibacterial wipes are to be used three times daily during the initial healing period to keep scab formation off the incision line and to treat the pre-existing vulvar fold dermatitis.

Typically, we will treat the underlying cystitis pre-operatively and continue antibiotics post-operatively if indicated.

Summary

The numerous advantages of CO_2 laser surgery—minimal hemorrhage, excellent visibility of the surgical site, precision and control over the amount of tissue removed and reduced post-op swelling—are invaluable in veterinary gynecology.

Vulvoplasty surgery is dramatically facilitated through the use of a surgical flexible waveguide CO_2 laser with a very high degree of surgeon, client and patient satisfaction. ●

Will Schultz, DVM, graduated from Michigan State University in 1973, went into private practice and opened his companion animal practice in the fall of 1974. He has been a board member on the Synbiotics Reproductive Advisory Panel, The Society for Theriogenology and The Theriogenology Foundation, with speaking engagements at veterinary conferences, veterinary associations and national specialties because of a special interest in canine reproduction. Soft tissue and orthopedic surgery are also areas of special interest with laser surgery being an important modality for him for more than 20 years. Dr. Schultz uses a 20-watt flexible waveguide CO_2 laser with constant and superpulse modes.

This Education Center article was underwritten by Aesculight of Woodinville, Wash., manufacturer of the only American-made CO_2 laser.

CO_2 Lasers Treat Many Feline Ailments

By Gary D. Norsworthy, DVM, Dipl. ABVP (Feline)
With Jennifer C. Olson, DVM

I have used a CO_2 laser for about 10 years. My initial interest in this tool was for declawing cats. I was told that using it would result in less bleeding and less pain. The difference between declawing with it and with a scalpel is not great in kittens, because they heal so rapidly; but the difference is obvious in adult cats, especially overweight ones.

Consequently, we abandoned other methods and made CO_2 declawing our only option to clients.

As we proceeded to use the CO_2 laser for declawing, creativity set in. I found that it is a tool that either exclusively permits accomplishment of certain surgeries or is superior to the other options. The following are applications that make feline practice more successful.

1 Lesions in Difficult Places

Oral tumors are frustrating because most affected cats are presented for drooling, poor appetite or fetid breath. Owners typically think there is a dental problem that can be solved with a good teeth cleaning or a few extractions. They are shocked to find that an aggressive, malignant tumor is present and that it is beyond surgical removal or response to chemotherapy or radiation therapy.

The CO_2 laser can permit tumor debulking and control for a few weeks. This gives the family time to deal with the impending loss of the cat (Figures 1A and 1B).

An odontogenic tumor (epulis) is an uncommon gingival proliferation that occurs around the teeth (Figure 3A). It can be temporarily removed with the CO_2 laser (Figure 3B); however, over time it will recur until the teeth are removed (Figures 3C and 3D). Removal of the tumor with the CO_2 laser should be performed and immediately followed by teeth removal.

Eosinophilic granulomas occur in many locations, including the base of the tongue (Figures 2A and 2B). In this location eosinophilic granulomas can make eating very difficult for the cat and result in significant weight loss. Although some respond to anti-inflammatory medications, response can be slow.

The CO_2 laser permits rapid debulking with control of hemorrhage. In some cases, a hemostatic powder can be a helpful adjunct therapy for bleeding. This treatment is followed with anti-inflammatory drugs to

Figure 1A

Figure 1B

PHOTOS COURTESY OF DR. GARY D. NORSWORTHY

PHOTOS COURTESY OF DR. GARY D. NOSWORTHY

Figure 2A

Figure 2B

Figure 3A

Figure 3B

Figure 3C

Figure 3D

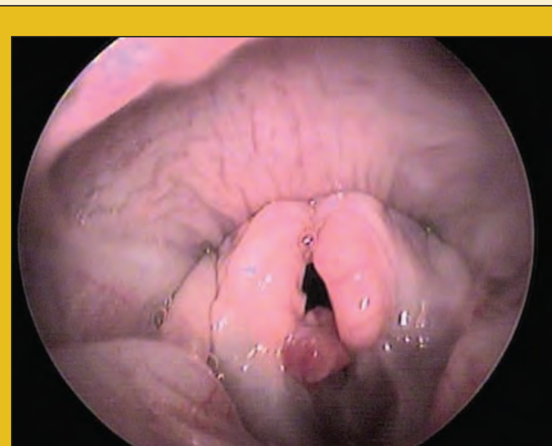


Figure 5A

Figure 5B


Figure 4A


Figure 4B


Figure 4C

complete the removal and prolong remission.

Facial tumors can be difficult to remove with conventional surgery because appropriate margins are frequently not possible. Figures 4A, 4B and 4C show a squamous cell tumor. The mast cell tumor did not recur; the squamous cell tumor recurred nine months post-operatively and was treated again with the laser.

Perilaryngeal tumors are not discovered until the cat develops respiratory stridor (Figure 5A). At this stage, open-mouth breathing may be present and the cat in a respiratory crisis. A video-otoscope can be a very useful tool in viewing this area and assessing the airway stricture. Biopsy forceps can pass through the working channel for tissue sampling.

The CO_2 laser, with a special tip that goes through the video-otoscope, can be used to treat these lesions and relieve the immediate respiratory crisis (Figure 5B). The ultimate treatment will depend on the histopathologic diagnosis.

2 Stenotic nares

Stenotic nares are often part of feline brachycephalic syndrome (Figure 6A). Opening the nares using conventional surgical techniques can be very difficult because of patient size. The CO_2 laser can open them in seconds (Figure 6B). The results are predictable, making it a what-you-see-is-what-you-get (WYSIWYG) procedure.


Figure 6A

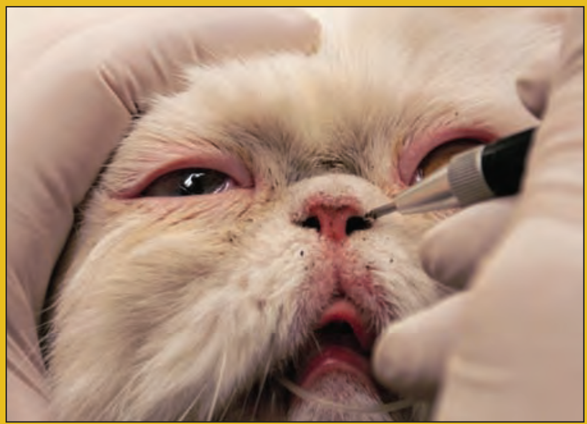


Figure 6B


Figure 7A


Figure 7B

3 Entropion

This is a relatively uncommon ocular disease in cats, but it can result in chronic keratitis and recurrent corneal ulceration (Figure 7A).

A row of X-shaped strokes are made with the laser parallel to the lid margins, resulting in a rolling outward of the lid margin (Figure 7B). This is another WYSIWYG procedure. The final result after healing should be virtually identical to the appearance at the end of surgery.

This Education Series article was underwritten by Aesculight LLC of Woodinville, Wash., manufacturer of the only American-made CO_2 laser.


Figure 8A


Figure 8B

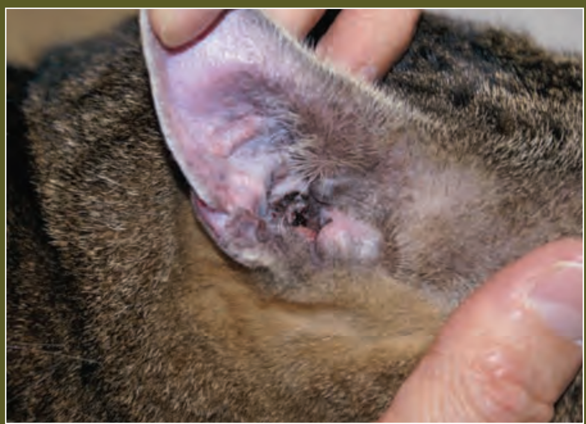


Figure 8C

4 Ceruminous gland adenomas

These are unique tumors of the inner surface of the pinna and the external ear canal and arise from the cerumen glands (Figure 8A).

Although the tumors are benign, they are unsightly and obstruct the flow of air in the external ear canal, resulting in chronic otitis externa. The CO_2 can easily vaporize the masses (Figure 8B). When healing is complete, the ear appears normal (Figure 8C). Unfortunately, affected cats form new masses over six to 15 months, so repeat therapy will be needed.

Summary

The CO_2 laser has many applications beyond declawing cats. It can offer options for therapy that are superior to other choices. ●

Dr. Norswrothy, in practice for almost 40 years, writes for a variety of veterinary journals and frequently lectures for veterinary associations. His Alamo Feline Health Center in San Antonio is South Texas's only hospital limited to cats and the only one that offers a truly dog-free environment.

Dr. Olson is a fourth-generation veterinarian. She, her great-grandfather, two grandparents and her father are all graduates of Cornell University's veterinary college.

CO_2 Laser Beneficial in Oncologic Surgery

By Barbara R. Gores, DVM, Diplomate ACVS
For The Education Series

Cancer is one of the most common causes for mortality in companion animals, affecting one in two pets over the age of 10. Surgery is still the most effective modality for the treatment of cancer because it can often provide an immediate cure or palliation of pain, with minimal and temporary side effects.

Laser techniques in oncologic surgery have become effective alternatives to radical tumor resection and to palliative tumor treatment methods.[1] CO_2 and Nd:YAG laser excision has been shown to provide almost a 50 percent improvement in the control of local disease in vivo compared with scalpel resection in rodent mammary gland tumors and human oral mucosal lesions.[2-5]

Lasers provide light with the necessary wavelength at the intensity sufficient for photodynamic therapy (PDT) for treating cancerous and non-cancerous lesions.[6,7]

The carbon dioxide (CO_2) surgical laser operates at a wavelength that is highly absorbed by water, therefore making it the most versatile and commonly used surgical laser available in veterinary medicine today. Despite the incredible development and advances that lasers have undergone in human surgical and therapeutic applications, lasers in veterinary practice have long been regarded as "surgical toys," given their expense and cumbersome size that previously made them impractical for use in private practice.

In the past two decades, technologic breakthroughs have resulted in compact, portable and reliable lasers that are economically feasible for both the general and specialty veterinary hospital. Laser use in clinical veterinary practice has become a beneficial tool for improved patient care and wider therapeutic options.

The human literature has demonstrated these beneficial effects in lab animal studies and human clinical trials. These studies support the use of laser energy for the enhancement of quality of life and control of disease in the veterinary patient, and provide a foundation for the commonly accepted laser surgical techniques and procedures that are continuously being implemented and refined in thousands of private veterinary practices around the world. Our pets can finally benefit from the very technology for which many research animals were utilized to perfect these laser surgical procedures in people.

Development of the light and flexible CO_2 laser hollow wave guide fiber technology in the early to mid-1990s, along with re-usable metal focused hand pieces that allow the surgeon to vary between large tissue ablation and precisely focused excision, has made this laser a highly beneficial tool in the veterinary practice.

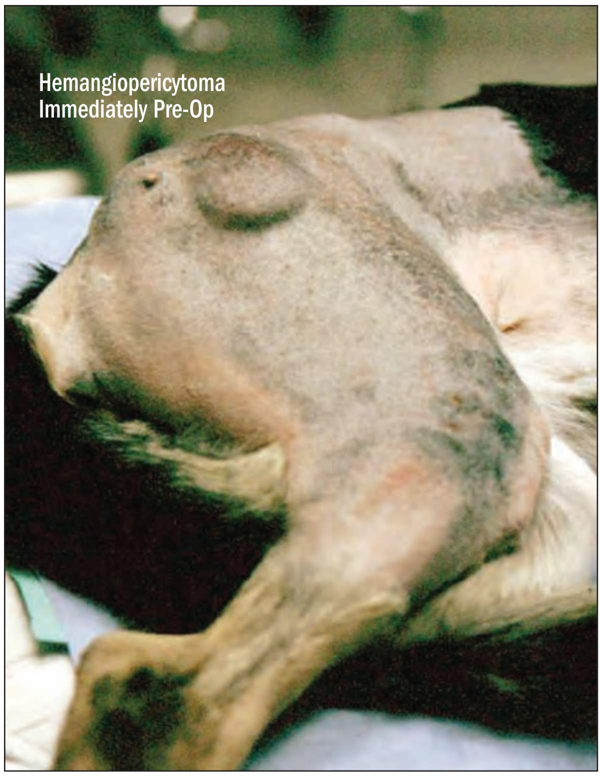
Laser techniques in oncologic surgery have become effective alternatives to radical tumor resection and to palliative tumor treatment methods.[1] Treatment will vary with the tumor type, extent of disease, prognosis and the owner's wishes. Thus, the surgical objective may vary from curative to palliative therapy.

I have used a CO_2 laser in my surgical practice for the past 16 years. The accompanying photos are a few case examples of the benefits of the CO_2 laser in in veterinary oncologic surgery.

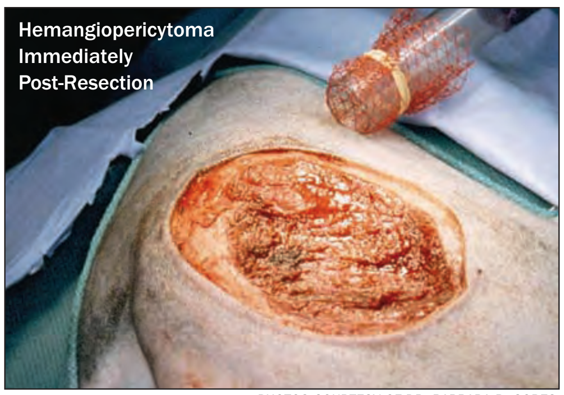
Soft Tissue Sarcomas

These can vary from low (hemangiopericytomas) to high grade and typically are slow to metastasize but have a high local recurrence rate due to the diffi-

Hemangiopericytoma


Hemangiopericytoma Immediately Pre-Op


Hemangiopericytoma Intra-Op


Hemangiopericytoma Immediately Post-Resection

PHOTOS COURTESY OF DR. BARBARA R. GORES

Grade 2 Soft Tissue Sarcoma


Grade 2 Soft Tissue Sarcoma Right Hip Immediately Pre-Op

Grade 2 Soft Tissue Sarcoma Right Hip 1.5 year Post-Op with No Recurrence


Grade 2 Soft Tissue Sarcoma Right Hip Intra-Op


Grade 2 Soft Tissue Sarcoma Right Hip Immediate Post-Op

culty in achieving wide surgical excision margins.

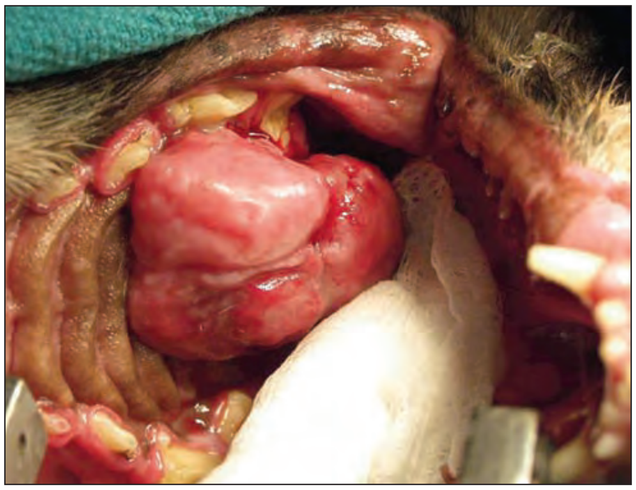
The CO_2 laser allows the surgeon to aggressively excise the underlying fascial plane while controlling hemostasis and providing good visualization. The laser light is absorbed by the tissues and converted to heat energy, sealing the small blood vessels and lymphatics by which microscopic tumor cells spread. Heat and decreased tissue manipulation decrease the chances of tumor seeding and recurrence.[4,5]

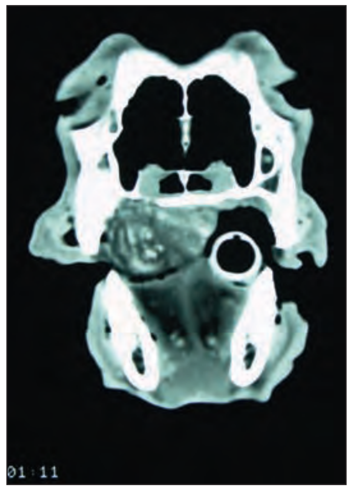
Oral Neoplasia

The oral cavity is the fourth most common location for neoplasia in small animals. Many times, tumors are very large by the time they are discovered and diagnosed. Often, curative excision is not possible. The CO_2 laser is an exceptional tool for palliative cytoreduction of these large oral tumors allowing tumor ablation, superior hemostasis and immediate comfort and return of function for the pet.

Barbara R. Gores, DVM, Dipl. ACVS, is a small-animal board certified surgeon in Tucson, Ariz., where she is the founding co-owner of the Veterinary Specialty Center of Tucson. She was the first laser-licensed veterinarian in the state. Before that she taught at the University of Minnesota College of Veterinary Medicine, Tufts University School of Veterinary Medicine and Angell Memorial Animal Medical Center, where she completed her small animal internship and surgical residency. Dr. Gores currently uses both the CO_2 and diode wavelengths in her practice.

Osteosarcoma of the Hard Palate/Maxilla CO_2 Laser Palliative Ablation


Immediately Pre-Op


CT Scan Pre-Op


1 Week Post-Op

Squamous Cell Carcinoma CO_2 Laser Curative Excision (Commissuroplasty)


Immediately Pre-Op


Intra-Op


Intra-Op Oral Mucosal Closure


Immediately Pre-Op

Malignant Melanoma CO_2 Laser Palliative Ablation


Immediately Pre-Op


1 Week Post-Op

FOOTNOTES...

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This Education Series story was underwritten by Aesculight LLC of Woodinville, Wash., manufacturer of the only American-made CO_2 laser.

CO_2 Laser Surgery: Dermatologic Applications

By David D. Duclos, DVM, Dipl. ACVD
For the Education Series

The carbon dioxide (CO_2) surgical laser has many advantageous uses and is the primary laser in use today in veterinary dermatology. State-of-the-art CO_2 lasers feature flexible fiber waveguide beam delivery with scalpel-like handpieces for surgical accuracy and precision.

The surgeon 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 used for ablating larger lesions. Because its wavelength is highly absorbed by water, little to no collateral tissue damage occurs when this laser is used properly.

The Animal Skin & Allergy Clinic in Lynnwood, Wash., has used the CO_2 lasers made previously by Luxar and now by Aesculight (both of Seattle) for more than 20 years in our dermatology practice. These lasers feature precision and reliability that are indispensable for a surgeon, including: A) convenience and pinpoint precision of scalpel-like handpieces; B) calibration of the distal end laser power; C) ability to defocus the beam to switch between incising/excising and large-area ablation; D) rugged design thanks to all-metal laser tube technology (In the 22 years I have used these lasers, I have never had a breakdown. One time the tube had to be recharged.); E) latest-generation laser handpieces use no disposables.

Some of the skin diseases we frequently treat include bowenoid in-situ carcinoma, apocrine cysts, nodular sebaceous gland tumors, follicular tumors (sometimes erroneously called sebaceous cysts), various nevi and skin tags, squamous cell carcinoma, precancerous actinic lesions on the nose and pinnae, and small tumors on the pinnae, muzzle, eyelids and paws. Many of these are treatable only with the CO_2 laser; others are more easily treated with laser surgery.

NODULAR SEBACEOUS HYPERPLASIA


Before surgery


During surgery

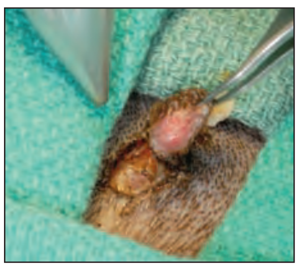

Immediately after surgery

APOCRINE CYSTS


Apocrine tumor ablation with 0.8mm spot size beam


Apocrine tumor ablation with 3mm x 0.4mm spot size beam

FOLLICULAR TUMORS

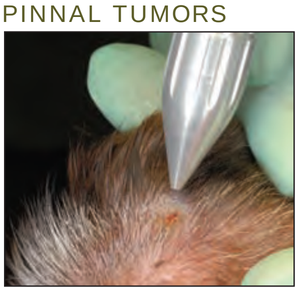

Follicular tumor excision with adjustable spot size tipless handpiece

MEIBOMIAN GLAND TUMORS


Before surgery

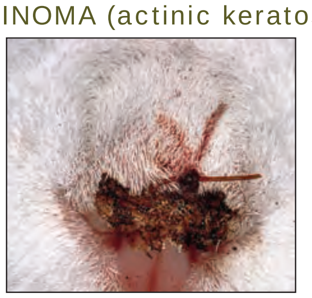

After surgery

PINNAL TUMORS


Pinnal tumor ablation with adjustable spot size tipless handpiece

ACTINIC IN SITU CARCINOMA (actinic keratosis)


Before surgery


Immediately after surgery


Two months after surgery

PHOTOS COURTESY OF DR. DAVID D. DUCLOS

Below are a few examples that demonstrate why the CO_2 laser is a necessary tool in today's veterinary dermatology practice.

Nodular Sebaceous Hyperplasia

Tumors such as nodular sebaceous gland hyperplasia are the most common example of tumors that are removed easily with laser ablation in comparison to the conventional cold steel methods. These tumors are often left untreated because of the amount of surgery needed to remove them through conventional scalpel surgery. Without the option of laser ablation, these clients are told they have to live with these wart-like growths on their pets because the removal is too extensive for the pet and too expensive for the client. Removal of single tumors is often done using local anesthetic and no need for surgical clipping and prep.

Apocrine Cysts

Tumors such as apocrine cysts in the cat are untreatable without CO_2 laser surgery. These tumors cause chronic problems in the ears and on the chin of cats. If treated early, they can be removed readily with CO_2 laser ablation.

Follicular Tumors

Removal of follicular tumors is much easier with CO_2 laser excision because of the advantage of minimal hemorrhage. The surgeon can easily see the tumor margins, and thus there is a smaller incision and less damage to the pet.

Meibomian Gland Tumors

Meibomian gland tumors on the eyelids are removed easily with CO_2 laser excision with minimal damage to the eyelids.

Actinic In Situ Carcinoma (Actinic Keratosis)

Actinic or precancerous, and even early cancerous lesions on the nasal planum, are easily removed with CO_2 laser ablation.

Pinnal tumors

Tumors on the pinnae are often difficult to remove with conventional scalpel surgical excision or without causing some disfiguration. Additionally, with conventional surgery, bleeding occurs and the lesions require sutures to control the bleeding. Furthermore, it is difficult to remove just the lesion; thus, adjacent normal skin and cartilage are often excised, resulting in further deformities of the pinnae. With the CO_2 laser, hemostasis allows tumor removal without the need for sutures. Also, the operator can limit removal to just the lesion, avoiding damage to adjacent normal structures. Laser ablation results in much less scar formation, and thus no to minimal deformity of the pinnae.

Conclusion

In most dermatologic surgical procedures using CO_2 lasers, no sutures are required and no post-operative care is needed. The pet does not bother the lesions because the nerve endings are sealed by the CO_2 laser, and thus little to no pain is present after the surgery. The advantages of minimal hemorrhage, precise control of how much tissue to remove and minimal post-operative swelling make the CO_2 laser an invaluable tool in veterinary dermatology. The diseases mentioned here are the ones for which the laser is better than conventional scalpel surgery; in many of these conditions, conventional surgery would not be possible.

Clinical advances would not have been possible without constant technological developments and instrumentation improvements by Luxar and Aesculight in close cooperation with veterinarians across North America. Modern-day CO_2 surgical lasers are compact, rugged and affordable state-of-the-art surgical tools with a scalpel-like feel and handling. Presently, with the increased number of veterinarians using these devices, the potential indications for their use are expanding.

Dr. Duclos is a small-animal practitioner in Lynnwood, Wash., where he is the owner and clinical dermatologist at the Animal Skin & Allergy Clinic. He completed his residency in veterinary dermatology at the University of Pennsylvania. He is an adjunct professor in the Washington State University College of Veterinary Medicine, teaching senior veterinary students as externs at his clinic.

This Education Series story was underwritten by AescuLight LLC of Woodinville, Wash., manufacturer of the only American-made CO_2 laser.

Soft Tissue Cutting with CO_2, Diode Lasers

By Peter Vitruk, Ph.D.
For The Educational Series

The cutting and ablation of soft tissue by CO_2 and diode lasers have been extensively studied and reported[1-3]. This article illustrates the easily observed practical differences between CO_2 and diode lasers with respect to their soft tissue cutting and ablation abilities.

Water Absorption Spectrum

Wavelength-dependent laser light's interaction with water (the dominant component of soft tissue) is the key to understanding how the laser light cuts soft tissue. See Figure 1.

The absorption/penetration depth in water for the CO_2 laser wavelength (10,600 nm) is 0.01 mm, which explains the very thin sub-100 µm thermal damage zone on the margins of the incision in soft tissue[1]. Such short penetration depth enables high precision in removing the tissue, and provides for sufficient hemostasis for sub-0.5 mm diameter blood vessels.

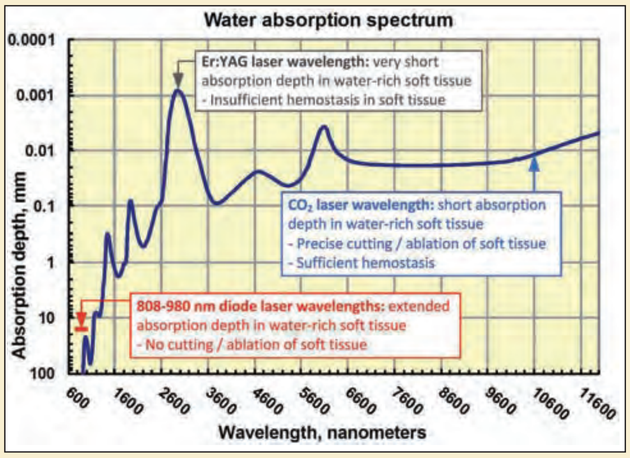


Figure 1

The absorption/penetration depth in water for the diode laser wavelengths in the 800-1,000 nm range is a thousand times greater than for the CO_2 laser wavelength. While hemoglobin and melanin do strongly absorb light in the 800-1,000 nm range, their relatively low concentrations in soft tissue result in a widely spread thermal damage zone of up to 8 millimeters[2,3].

Such deep subdermal penetration of diode laser light enables many useful non-surgical applications such as hair removal, spider vein reduction, biostimulation, etc.

CO_2 Laser-tissue Interaction

Figures 2 and 3 illustrate the interaction of CO_2 laser light at 10,600 nm with fresh poultry muscle tissue. The CO_2 laser beam from an Aesculight AE-3020 laser, focused to 0.25 mm spot size (Aesculight Tipless Handpiece) at 7 watt continuous wave in SuperPulse mode, produces a clean incision with char-free (carbon-free with no evidence of burning) margins with minimal thermal damage; see Figure 2.

The same laser with a larger spot size (Aesculight Wide Ablation Tip) at similar average power (6 watt; mode A14 SuperPulse at 20 watt with 30 percent duty cycle) to the tissue produces a 3 mm wide sub-mm deep ablation path—see Figure 3—a useful modality for tumor debulking, scar removal, wound cleaning and a variety of dermatological applications, etc. The CO_2 laser-tissue interaction is always predictable and is based on laser beam spot size, and laser beam power.

Diode Laser-tissue Interaction

Figures 4-7 illustrate the use of diode laser at 810 nm with the same tissue sample, the same average laser power (7 watts continuous wave) and similar spot size (0.3 mm) as used for CO_2 laser cutting settings presented in Figure 2. Diode laser use in "non-contact" mode is represented in Figure 4A (laser beam on) and Figure 4B (laser beam off); no tissue is removed regardless of exposure time while sub-surface thermal necrosis may extend for up to 8 mm deep[2].

Diode laser use in "contact" mode with a fresh and clean distal glass fiber tip firmly pressed against the soft tissue surface is presented in Figure 5A (laser beam on) and Figure 5B (post-lasing). Just as with "non-contact" mode, no tissue is removed regardless of exposure time while sub-surface thermal damage may be very wide spread and extensive[2].

The key to soft tissue removal with the diode laser is the carbon-rich black ink or char deposited on the diode laser's fiber glass tip in order to initiate or activate it—see Figure 6A. The char absorbs the diode laser light and blocks it inside the glass tip. The glass tip then heats up where it can burn the soft tissue upon contact; see Figure 6B.

Such thermal tissue removal is a slow heat-conduction process that depends on how charred and how hot the glass tip is. Slow tissue removal induced thermal necrosis of up to 6 mm deep[3] is manifested by extensive char left at the margins of incision, and by white "seared" discoloration outside of the charred margins of incision, seen in Figure 6B. An often overlooked aspect of using a hot charred glass tip for soft tissue removal is the thermal stress induced fracture of the fiber and loss of the broken tip inside the tissue; see Figure 7.

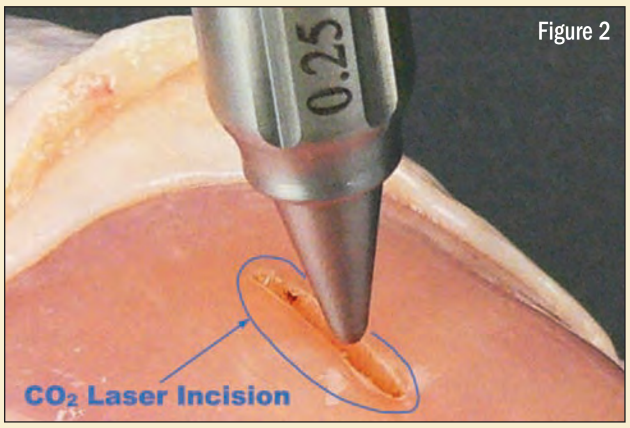


Figure 2

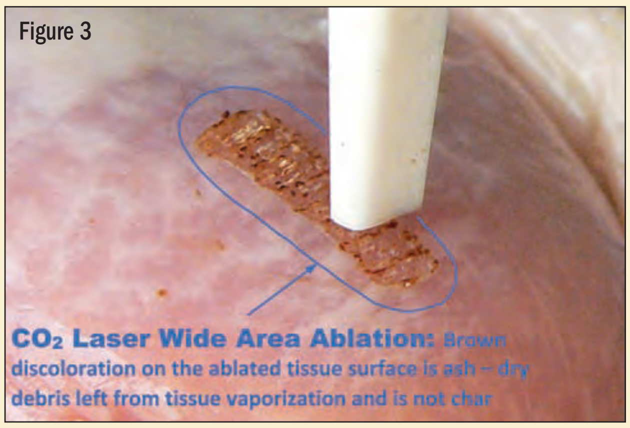


Figure 3

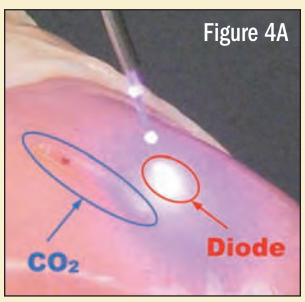


Figure 4A

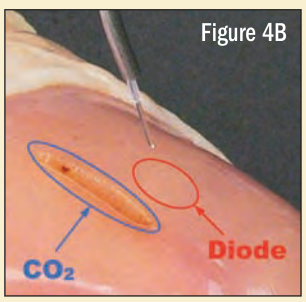


Figure 4B

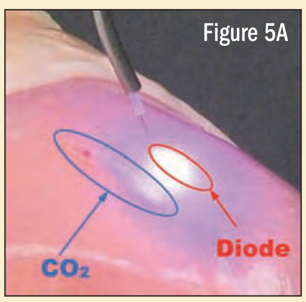
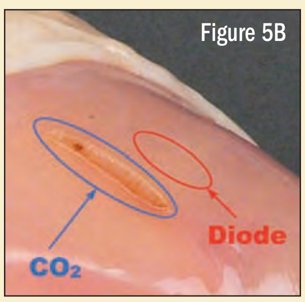


Figure 5A



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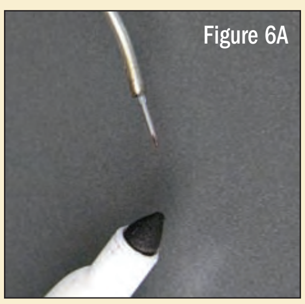

Figure 6A

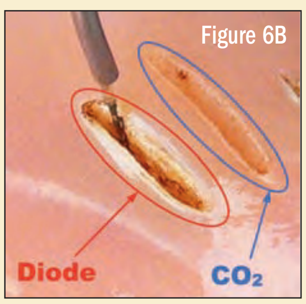

Figure 6B

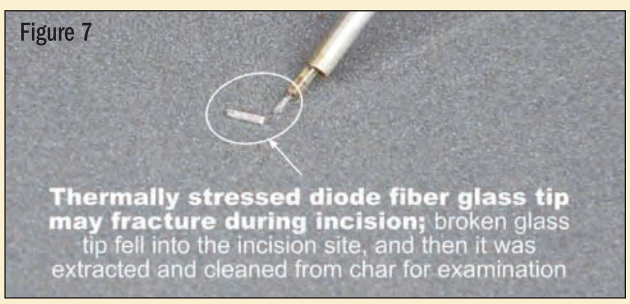

Figure 7

Summery

Diode laser light does not ablate soft tissue; it is used indirectly to heat up the optically "black" char on the tip of glass fiber; then the hot charred glass tip cuts the tissue by burning it away upon contact. Excessive char and thermal necrosis along with the possibility of a thermal stress-induced fracture of the glass tip inside the surgical site make the diode laser a "What you don't see can hurt you" tool for soft tissue surgery.

A diode's fiber hot glass tip is best used surgically where the use of CO_2 lasers is limited (fluid filled surgical site or with flexible endoscopes), while diode laser light has a number of non-surgical applications such as biostimulation, etc.

CO_2 laser light's ability to ablate and cut the water-rich soft-tissue with maximum precision and minimal collateral thermal effects[1] makes it a true "What you see is what you get" surgical laser with a short learning curve and a great variety of uses in general surgery. The sub-100 µm deep thermal effects on the margins of the incision are sufficient for sealing the blood vessels, lymphatics, and nerve endings, while the 10,600 nm laser light efficiently sterilizes the margins of incision by destroying surface bacteria. ●

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Dr. Vitruk is the founder and CEO of Aesculight LLC and Luxarcase LLC in Woodinville, Wash., and is a member of The Institute of Physics in London.

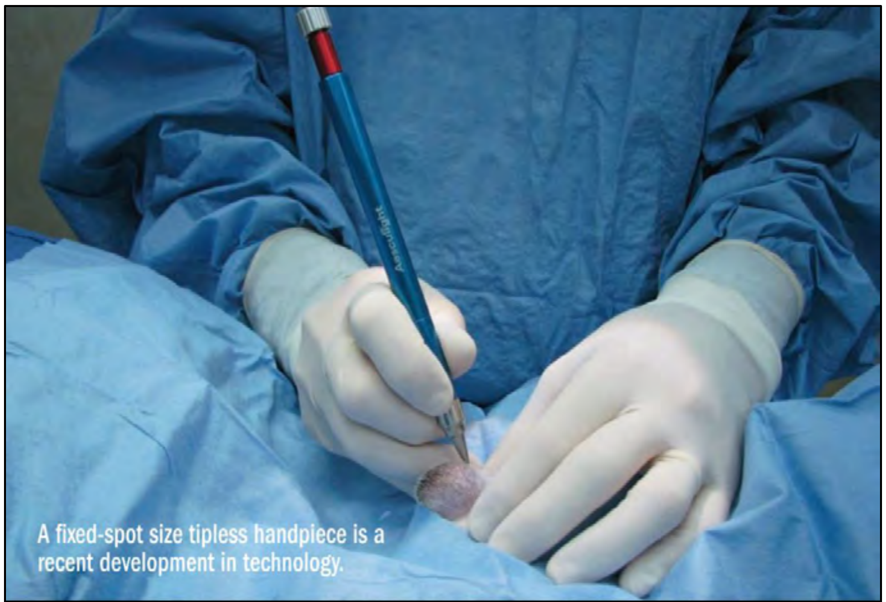
This Education Series story was underwritten by Aesculight LLC of Woodinville, Wash., manufacturer of the only American-made CO_2 laser.

CO_2 Laser Surgery: Standard of Care

By John C. Godbold Jr., DVM
For The Education Series

Carbon dioxide (CO_2) lasers have become a standard of care in veterinary surgery. Delivering the ideal wavelength (10.6 µm) for all soft tissue surgery, CO_2 lasers provide increased precision and result in reduced hemorrhage, swelling, pain and tissue trauma. CO_2 lasers also facilitate many laser-improved and laser-specific procedures.

Since entering veterinary medicine in the late 1990s, flexible hollow wave guide CO_2 lasers have been adapted to the needs of diverse practice types. Now mainstream, this cutting-edge technology is being used in general practices as well as specialty and referral practices.



A fixed-spot size tipless handpiece is a recent development in technology.

PHOTOS COURTESY OF DR. JOHN C. GODBOLD JR.

Clockwise from top left: Pre-, during, and after photos of the ablation of nasal hyperkeratosis performed by Dr. Godbld. He considers hyperkeratosis a laser-specific procedure: 'It just can't be done any other way.'

General Small Animal Practice

Thousands of small-animal practices in North America use CO_2 surgical lasers every day. Jeff Goodall, DVM, of Sunnyview Animal Care Centre in Bedford, Nova Scotia, notes, "We purchased the CO_2 laser in November 2003, and we made the use of the laser mandatory for elective surgeries within one year of purchase."

He reports that he now uses his flexible hollow wave guide CO_2 laser in over 98 percent of his surgeries.

Dr. Goodall's CO_2 laser also facilitated other welcome developments in the practice by "attracting more qualified and experienced staff to our practice when we advertised for positions. They were looking for a laser practice, and we inherently had standards that attracted them." With his CO_2 laser, Goodall established a standard of care that allows him to do better surgery and to attract the best staff and the best clients.

Dermatology Practice

CO_2 surgical lasers have become a standard of care in specialty practices as well, such as in Dr. David Duclos' Animal Skin and Allergy Clinic in Lynnwood, Wash. Duclos was one of the first veterinary dermatologists to use the CO_2 laser in his specialty.

He notes that his CO_2 laser "removes tissue with less bleeding, less pain and swelling, and because it can be focused precisely, it will only remove the desired tissue without damage to the surrounding structures."

Avian and Exotic Practice

Avian and exotic practices also have experienced paradigm shifts in terms of their standard of care.

Lee Bolt, DVM, of Asheville, N.C., is a pioneering veterinarian in the avian and exotic specialty.

"I have been using a CO_2 laser since 1999 in my small animal and exotics practice," Dr. Bolt says. "I wouldn't practice without it now. I use it every day."

With respect to his equipment preferences, he adds, "I have a diode laser, but the CO_2 laser is the way to go if you have to pick the most versatile modality."

Equine Practice

Many large-animal practices incorporate CO_2 lasers. Because of horses' thicker tissues, higher-powered laser systems are often favored by equine surgeons.

"I recently upgraded to the 40 watt CO_2 laser and I have been impressed with the ability to treat the large tumor masses that I often have to deal with," reports Robert V. Fleck, DVM, of Rainland Farm Equine Clinic in Woodinville, Wash.

"I also have found the higher wattage and superpulse setting have made incisions a breeze since the horse has relatively thick skin. All in all, I don't know how I could go back to a pre-laser practice situation."

Feline Practice

CO_2 surgical lasers are important in feline practices as well.

Judy Karnia, DVM, owner of the Scottsdale Cat Clinic in Scottsdale, Ariz., a feline-only practice, notes that she uses a CO_2 surgical laser "for all surgical procedures. It enables us to perform surgeries more quickly.

"We definitely see an improvement in recovery for the patients. We also believe that our clients regard the fact that we use the surgical laser as one more proof that we strive to offer the best medical care we can."

Melissa Suarez, DVM, of Arbor Hills Veterinary Centre in Plano, Texas, explains: "The critical difference is hemostasis. With the laser, there is no tourniquet and there is no bleeding."

Mobile Practice

In central North Carolina, accomplished CO_2 laser surgeon has taken her laser on the road. Janine Sagris, DVM, began her practice in 2008 in a 24-foot mobile veterinary hospital. Since then, the clientele of Mobile Laser Veterinary Services has grown exponentially.

"I have a flexible hollow wave guide CO_2 laser in my mobile surgery suite," Dr. Sagris says. "The laser is not optional for my personal pets, so I have the same high standard of care for my clients and patients. I perform everything from spays and neuters to leg amputations and soft palate resections with my CO_2 laser.

"Other veterinarians call on me to perform laser surgeries on their personal pets,"Sagris reports. "I also get many surgical referrals from other veterinarians for specific laser procedures on their clients' pets."

Referral Practice

Barbara R. Gores, DVM, an ACVS board-certified surgeon and a founding owner of Veterinary Specialty Center of Tucson, Ariz., uses her CO_2 laser every day.

"I use the CO_2 laser in the majority of my soft-tissue procedures because of the advantages both to me as the surgeon and to my patient, Dr. Gores says.

"I perform a lot of tumor removals, and the laser allows me to do a much more thorough job of dissection and excision of these neoplasms. I have so much better hemostasis. I can concentrate on achieving the most ideal tissue planes in my dissection, rather than spending my time on controlling bleeding and hemorrhage.

"The improved visualization allows me to perform a much more accurate dissection."

Gores adds that "Due to the non-contact nature of laser surgery, there is much less tissue manipulation, which greatly reduces swelling and edema, thereby greatly improving patient comfort postoperatively. This lessens the incisional licking, scooting and rubbing, which makes both the pet and the owner much happier."

Conclusion

Hollow wave guide CO_2 lasers are now an important tool in veterinary surgery. They have become a standard of care in general practices and in specialty and referral practices.

The technology has continued to develop with the Introduction of higher powered lasers that allow broader use and the development of more laser-specific applications. Continued refinements, like tipless handpieces for the flexible hollow wave guide lasers, ensure that their use will continue to elevate the quality and scope of veterinary surgery.

John C. Godbold Jr., DVM, is a small-animal practitioner from Jackson, Tenn. With a special interest in laser technologies, he has been a frequent continuing education presenter throughout North America and Europe for more than 10 years, and has trained thousands of colleagues how to use their CO_2 lasers.

This Education Series article was underwritten by Aesculight LLC of Woodinville, Wash., manufacturer of the only American-made CO_2 laser.

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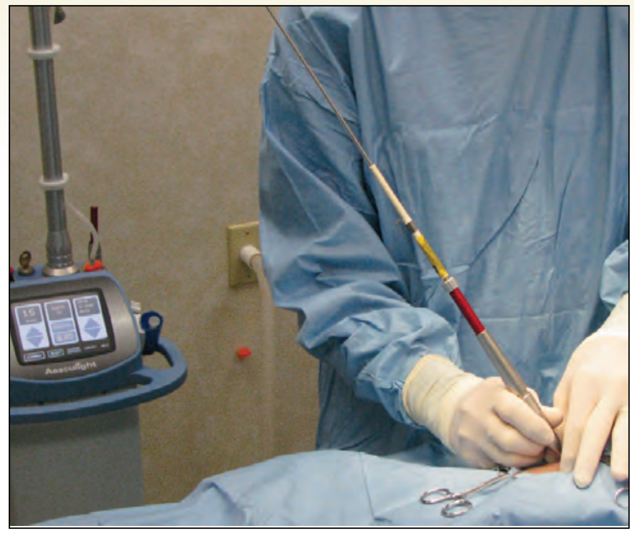
Veterinary Practice News



CO_2 Laser Surgery: Selecting the Best Delivery System

By John C. Godbold Jr., DVM
For Veterinary Practice News

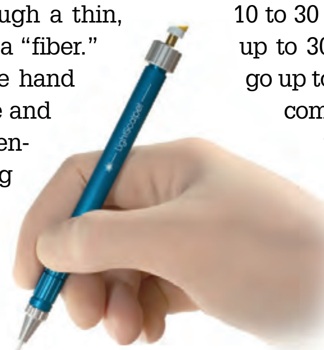
Carbon dioxide (CO_2) laser use is widely accepted in veterinary surgery because of its advantages: reduced hemorrhage, swelling and pain, increased precision and minimal tissue trauma, and because of the development of many laser-improved and laser-specific procedures.

The popularity of veterinary CO_2 laser surgery has attracted many vendors. Each vendor contends that its laser is the best and its marketing creates confusion for veterinarians considering laser devices for their practices. The most important decision when selecting a laser is which delivery system to purchase. What is available? Which best meets patients' needs? Which will be used most often? Which will give the greatest return on investment?

CO_2 Laser Delivery Systems

Articulated Arm (AA) laser technology was developed in the 1970s. AA lasers deliver the laser beam to the tissue through a sophisticated four elbow, seven mirror articulated arm. The laser beam is focused 2-3 cm from the hand piece by a lens in the hand piece's base. Since the operator must hold the hand piece away from the tissue for the beam to focus, these devices require a visible aiming beam.

Hollow wave guide (HWG) lasers were developed in the 1990s and deliver the laser beam through a thin, flexible, hollow waveguide commonly called a "fiber." The beam exits through either a pencil-size hand piece, focused by interchangeable, reusable and autoclavable focusing tips, or through a slender, adjustable tipless hand piece. Focusing tips and the adjustable tipless hand piece have focal lengths of 0.75 – 3 mm, so both are held very close to the tissue. No aiming beam is required.



Hollow Wave Guide (HWG) Laser Hand Piece

Articulated Arm (AA) Laser Hand Piece

Factors in Selecting a Delivery System

Ergonomics. The thin, flexible HWG and its pencil-like hand pieces are easy and comfortable to use. Its flexibility allows for convenient positioning and suspension of the hand piece over a mayo stand for ready access. The thick and restricted-movement AA delivery system limits laser position, and doesn't always allow suspension of the hand piece at an appropriate height above a mayo stand. The weight, size and bulk of the AA system can result in arm and hand fatigue.

Availability of Multiple Spot Sizes. HWG lasers offer multiple size focusing tips that can be quickly and easily changed during surgery: 0.2, 0.25, 0.3, 0.4, 0.8, 1.4 mm, or 0.4 mm x 3 mm. This variety of tip sizes allows the surgeon to select the size that will produce the best effect. AA lasers offer one fixed focal spot size, usually .2 - .25 mm.

Precision. The HWG hand piece is held very close to the tissue, allowing enhanced precision and use in a great diversity of procedures. It is aimed from a distance of 0.75 to 3 mm, allowing the surgeon to gain maximum stability by resting the hand holding the hand piece on the patient. AA delivery hand pieces are held 2 to 3 cm from the tissue, resulting in less precision and requiring a visible aiming beam which is 10 or more times the diameter of the laser beam. AA lasers are effective for simple skin incisions and gross dissection, but not for procedures requiring precision.

Ability to Defocus. Maximum power density is desired for cutting or removing tissue, but reduced power density can be used for hemostasis and contracting tissue. HWG focusing tips, having a focal length of 0.75 to 3 mm, produce a laser beam with wide angles of convergence and divergence and allow adjustment of power density with slight hand movement, by backing away from the tissue. AA laser hand pieces utilize a focusing lens with a fixed, 50 to 100 mm focal length. Its laser beam has very narrow angles of convergence and divergence and can only be defocused by backing the hand piece a great distance away from the tissue.

Laser Power. Small-animal surgeons need no more than 30 watts of power. AA lasers for veterinary use range from 10 to 30 watts. HWG lasers for small animal use go up to 30 watts. For large-animal use, HWG lasers go up to 40 watts and represent the highest power commercially available for veterinary applications. Difference in cost of the two delivery systems is negligible when comparing devices of equal power.

Beam Pulse Configuration. The best tissue effect is achieved by modifying laser beam pulse configuration according to tissue characteristics. The newer technology metal laser tubes of HWG lasers allow complex pulsing and offer pulse mode options for best tissue effect. The older technology glass laser tubes in AA lasers do not allow complex pulsing.

Safety. Because of the wide angle of divergence of HWG focusing tips and the rapid defocusing of the beam, the danger zone for eye injury is relatively short. With the narrow angle of divergence of the AA focusing lens system, the laser beam maintains high power density for a great distance. The potential danger zone is much greater with AA devices.

Calibration. HWG lasers have an external calibration feature so that the energy exiting the delivery system is precise. AA lasers rely on an internal power meter that monitors the energy entering the delivery system. Energy attenuation within the AA delivery system may affect the energy exiting the system.

Disposables. AA lasers have no disposables. Modern hollow wave guides are durable and have long life. (The author has used a single HWG for as long as five years in thousands of surgeries.) Focusing tips for HWG lasers are reusable and have a virtually infinite life span. HWG's latest advancement—a tipless hand piece—not only eliminates tips, but offers multiple spot size options in one autoclavable device for faster and better handling.

Maintenance. Long-term cost for any piece of capital equipment depends on the credibility of the manufacturer and the reliability of its service organization. Firms with positive testimonials and references are much preferred. Veterinarians should avoid vendors that do not have well established service capabilities with long-term service contracts, loaner policies and quick turn-around of repairs.

Training, education and clinical reference materials. The overwhelming popularity of HGW lasers means virtually all laser surgery courses, workshops and wet labs focus on and use the HGW lasers. Since HWG lasers have been the most used in practice, the body of clinical knowledge generated over the last 15 years is about HWG technique and its application in procedures and surgeries. HWG lasers now feature an on-board atlas of laser surgery with procedures, settings, pictures and videos. With no comparable body of knowledge, AA laser owners must extrapolate recommendations for HWG lasers to their own devices and apply that information to the limited number of HWG procedures in which AA lasers can appropriately be used.

Return on investment. To justify purchase, capital equipment must be used often enough to generate revenue to pay for itself and make it profitable. Lasers can be very profitable if used frequently. Because of their versatility, HWG lasers can appropriately be used in virtually every surgery done in practice. Their ROI is very short. AA lasers have limited applications and require longer time for ROI.

Conclusions

A surgical laser will enhance surgical capabilities in a general practice. Selection of the delivery system is the most important consideration. Prospective surgeons should carefully consider the differences in the delivery systems prior to purchase.

(**Note:** The author owns two surgical lasers – a 30-watt articulated arm laser and a 30-watt hollow wave guide laser. With full understanding of the issues discussed in this article, the author uses his HWG laser every day. His AA laser sits idle.) ●

Dr. Godbold established Stonehaven Park Veterinary Hospital in Jackson, Tenn., in 1980. Since 1999, he has pursued a special interest in surgical lasers and laser-associated technologies.

This Education Series article was underwritten by LuxarCare of Woodinville, Wash.

CO_2 Surgical Laser for Equine Veterinarians

By Robert Fleck, DVM
For The Education Series

I have been using lasers (CO_2 and diode) in my equine-only practice for the last six years. I have discovered many uses that have immensely expanded my surgical and therapeutic capabilities. While the diode is primarily used for endoscopic surgery of the upper respiratory and urogenital regions, most of my laser use involves the CO_2 surgical laser, which brings many benefits to my equine procedures.

The CO_2 laser's wavelength of 10,600 nm is highly absorbed by soft tissue[1]; this unique aspect of the carbon dioxide laser enables precise dissection and vaporization of soft tissue with minimum hemorrhage as well as reduced postoperative pain and swelling (due to the coagulation of nerve endings and lymphatics along the edges of incisions).

Whether doing incisions, excisions, dissections or ablations, CO_2 laser surgery is always noncontact; therefore it minimizes tissue trauma while providing a strong sterilizing effect by killing surface bacteria.

CO_2 Laser Uses

With my CO_2 laser, I have been impressed with the reduced inflammation and swelling of the surgery sites, especially in cases involving castration of the mature stallion. Small bleeders may be controlled by raising the handpiece away from the tissue, defocusing the laser beam and coagulating the affected surface of the vessel wall.

After performing closed castration in normal stallions (see Figures 1 and 2), we see horses returning to training very quickly and without the threat of evisceration. Further, my laser's flexible waveguide enables superior reach and ergonomics during operation in this area (more on this later).

I also use the CO_2 laser a lot for tumor debulking and ablation. Having used cryotherapy for tumor therapy for over 30 years, I now perform almost all treatments with the CO_2 laser. Tumors I regularly deal with include melanomas, squamous cell carcinomas, mastocytomas and equine sarcoids.


Figure 1


Figure 2

The 40 watt Aesculight CO_2 laser has impressive ability to treat large tumor masses. It is useful for treating cutaneous tumors in the horse, including equine sarcoid, squamous cell carcinoma and melanoma. Tumor debulking, ablation and dissection with limited hemorrhage are facilitated with the CO_2 laser.

It enables thermal coagulation of the surgical margins; the thermal effect assists in eliminating abnormal cells left by conventional surgical techniques. The laser thermally seals blood and lymphatic vessels by which the microscopic tumors spread; this, with decreased tissue manipulation, decreases the rate of tumor seeding and recurrence[2,3].

The use of the laser in treating melanomas in the gray horse is illustrated in Figure 3 (pre-operative), Figure 4 (intra-operative), and Figure 5 (immediately post-operative).

CO_2 Laser Power Settings

The power of the CO_2 laser is critically important for high quality incisions, excisions and dissections performed in one path with minimum thermal damage to the margins—the higher the power, the faster the incision can be performed without multiple back and forth movements of the laser beam.

Equally important is the power of the laser for large area ablations—the higher the power, the larger the area that can be treated in the minimum amount of time. Thus, higher laser power is preferred, especially for equine and large animal surgical procedures[1].

Last year I upgraded to a 40 watt Aesculight CO_2 laser. It is the highest power CO_2 laser for veterinary use, and it is the only flexible waveguide fiber laser on the market with extended reach appropriate for open field equine surgery, as illustrated in Figure 1.

Combined with fiber flexibility and a selection of different attachments, the 40 watt model is a long awaited upgrade most suited for large animal and equine surgeries. I have found that the higher wattage and Superpulse settings have made incisions a breeze (even with the horse's relatively thick skin).

Beam Delivery and Accessories

One of the best upgrades is the new flexible waveguide fiber, allowing easier handling of the laser handpiece with a greater control of beam spot size as well as the benefit of rapid defocusing for safety and versatility. My flexible fiber laser handpieces also have a relatively shorter tip-to-tissue distance, are more precise and offer multiple-spot sizes while articulated arm lasers do not. The flexible fiber is ergonomic and easy to use, unlike the heavier articulated arm laser that I previously owned.

There are several important laser accessories that I use regularly. In addition to a regular laser handpiece with interchangeable laser tips of different lengths and focal spot sizes (Figure 4), the new adjustable tipless handpiece, shown in Figures 1 and 2, allows for more options like changing the laser spot size intraoperatively without changing the handpiece.

The handpiece incorporates four spot sizes: 0.25 mm and 0.4 mm spot sizes for excisions, incisions and dissections; and 0.8mm and 1.4 mm for large-area surface ablations. The other tipless handpiece design with fixed, interchangeable spot size nozzles enables more visibility and improves handling ergonomics.

Also, Aesculight's exclusive "paintbrush" laser tip produces a 3 mm x 0.4 mm beam useful for ablating of large surface areas at the highest laser power settings.


Figure 3


Figure 4


Figure 5

Summary

The main advantages of the CO_2 wavelength technology (10,600 nm) for soft tissue surgery include reduced tissue trauma, precise dissection, sterilization of the tissue surface (as the laser beam kills surface bacteria), reduced operative hemorrhage, quickened healing and reduced post-operative pain. My clients regularly comment on how good the surgical sites look.

Dr. Fleck is a graduate of the University of California, Davis. He founded the Rainland Farm Equine Clinic in 1975 and has expertise in nuclear scintigraphy (bone scan), lameness examinations and breeding as well as reconstructive, laser and arthroscopic surgery.

FOOTNOTES...

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This Education Series article was underwritten by Aesculight LLC of Woodinville, Wash., manufacturer of the only American-made CO_2 laser.

CO_2 laser surgical approach to the ventral abdominal incision

By Paul Sessa, DVM
For The Education Center

Introduction

As mentioned in the article "Benefits of CO_2 Laser Onychectomy" in the April issue, the Aesculight CO_2 laser is my surgical tool of choice **(Figure 1)**. If asked, I would estimate that 98 percent of our general surgeries are now performed with this laser and the new adjustable spot size tipless Aesculight laser handpiece.

This article covers the most common use for our laser, the ventral abdominal incision, which is probably the most frequent surgery in every general practice.

Applications

Over the last 10 years, our practice has adopted the laser as the exclusive soft tissue surgical instrument for all of our spays and neuters. We routinely use our CO_2 laser for ovariohysterectomies, c-sections, cystotomies, cryptorchid neuters and exploratory surgeries, including pyometras, GI foreign bodies and so on.

For most approaches to the abdomen, the midline abdominal incision is used. The ability to enter the abdomen and maintain a dry surgical field is a distinct advantage that the laser offers over conventional scalpel surgery.

Techniques and Challenges

Laser surgery presents the novice laser surgeon with certain challenges, which in my own experience are easy to overcome with time and practice.

The technique that is most difficult for the new laser user to master is the art of distracting the incised tissues without touching them with the laser tip. This is a fairly common early frustration but usually is easily mastered and will become second nature for most laser surgeons.

The bloodless skin incision facilitates visualization of the linea. Even in very obese patients the midline of the subcutaneous fat is visualized and incised all the way to the linea **(Figure 2)**.

Another helpful technique is to use the laser instead of scissors to minimally reflect the subcutaneous fat from the linea alba **(Figure 3)**. This also helps keep the incision field dry, minimizing postsurgical bruising and pain for our patients, which pet owners appreciate.

The linea alba in some patients can be a challenge to identify even for experienced surgeons. Paramedian incisions can cause some significant bleeding and make abdominal evaluation at closing a concern for some new surgeons.

Being off the midline with the CO_2 laser, however, is not a concern.

Figure 1. Dr. Sessa operating

PHOTOS COURTESY OF DR. PAUL SESSA

The hemostasis afforded by the laser allows the surgeon to quickly get back to the midline, or, if desired, continue the paramedian incision and maintain better visualization and hemostasis. **Figure 4** demonstrates a paramedian incision during a routine ovariohysterectomy with the bloodless surgical field.

It is important to use a backstop instrument to limit the

Figure 2. Approaching the linea alba

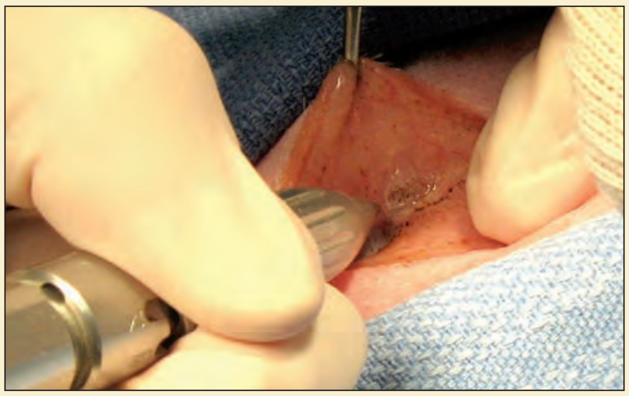

Figure 3. Reflecting fatty layer from linea alba

Paramedian incision during a routine ovariohysterectomy. Notice the excellent hemostasis

Figure 4.

Using instrument to back-stop the linea incision during a routine ovariohysterectomy

Figure 5.

Figure 6. CO_2 laser ovariohysterectomy/laparotomy

Figure 7. Intraoperative view: feline pyometra surgery

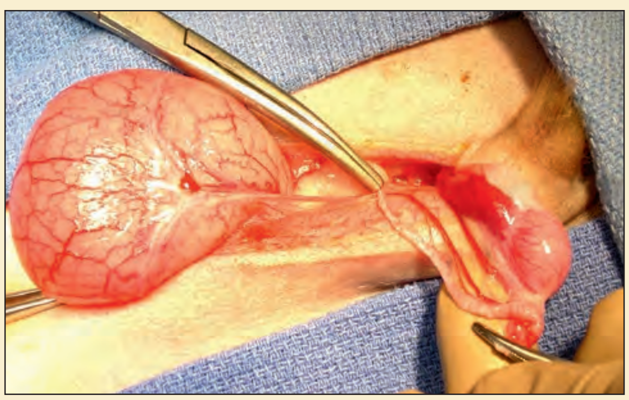

Figure 8. Canine cryptorchid neuter

Figure 9. Feline cryptorchid neuter

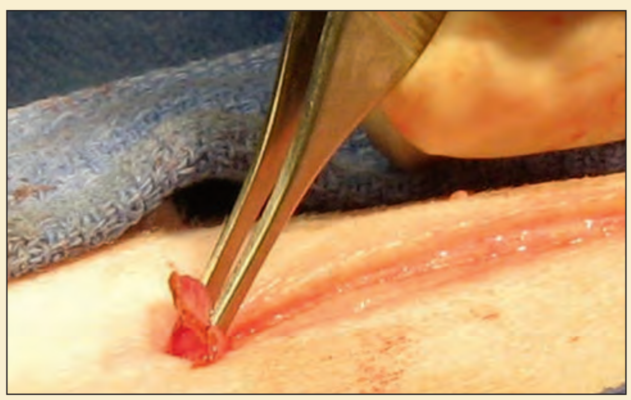

Figure 10. Uterine body severed with the CO_2 laser

Figure 11. CO_2 laser incision of the bladder

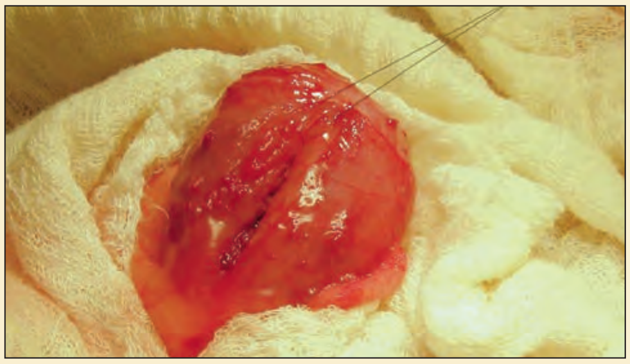

Figure 12. The bladder wall incision at closing

Figure 13. The CO_2 laser incision at closing

depth during linea incisions, such as the thumb forceps or other instrument of the surgeon's choice (**Figure 5**).

Incision Length

The routine spay incision can be as small or large as the surgeon prefers. The healing process is side-to-side so the length of incision is a matter of personal preference. I prefer greater visualization over small incisions as we are not in the high-volume spay and neuter business (see **Figure 6** featuring laser laparotomy during a routine ovariohysterectomy and **Figure 7** showing a large incision during a feline pyometra surgery).

The ability to get a clear view of the structures is paramount.

This Education Center story was underwritten by Aesculight of Woodinville, Wash., manufacturer of the only American-made CO_2 laser.

Other Applications

The cryptorchid dog neuter is my personal favorite laser use. The incision is made along the prepuce and the laser allows for precise dissection with the ability to avoid the various large vessels that occur in this area.

The midline of the male can be identified and, though it is not as prominent as in most spays, it is easily incised and bleeding is minimized tremendously by the laser coagulation of the target tissues during the incision. For example, **Figures 8 and 9** demonstrate virtually bloodless canine and feline cryptorchid neuters, respectively, and **Figure 10** shows the uterine body severed with the CO_2 laser.

Bladder surgery is another of my favorite laser applications. The standard approach to the abdomen and the incision of the bladder in our practice are done exclusively with our CO_2 laser (**Figures 11-13**). The most bleeding will occur during the suturing of the bladder wall (**Figure 12**).

Conclusion

In ventral abdomen surgery, the CO_2 laser offers numerous advantages over the conventional steel blade. Mainly, it is the precision of the cut and the ability to seal blood vessels along the incision. Laser surgery also ensures a better aesthetic result, less post-surgical bruising, and reduced swelling and pain for the patients, which is highly appreciated by pet owners. ●

Dr. Paul Sessa earned his DVM from the University of California, Davis, in 1984. He practiced medicine in Escalon before joining the Veterinary Emergency Clinic in Modesto, Calif., in 1985. In 1990 he transferred to the Associated Veterinary Emergency Services Clinic in Stockton, Calif., while developing his Animal Home Health Mobile Care practice. Dr. Sessa now practices at Salida Veterinary Hospital in Salida, Colo.

CO_2 laser excision of skin tumors

By David D. Duclos, DVM, Dipl. ACVD
For The Education Center

The CO_2 laser uses a focused beam of light to cut tissue. The size of this cutting beam can be as small as 0.25 mm in diameter.

This small cutting tip enables the surgeon to excise lumps and bumps via small openings, smaller than was ever possible with steel scalpel blades.

Black markings in **Figure 1** denote wide surgical margins around the tumor as is typically done with the scalpel. Most skin nodules are not malignant (and do not require wide surgical margins), but some can be. Therefore, the tumors should be submitted for histopathologic evaluation.

With the CO_2 laser, incisions can be made close to or inside the outer visible edges of the tumor (e.g., **Figures 3b-3e**). The ability to excise a tumor via smaller openings is critical in areas where there is not enough skin to excise with the tumor (e.g., tail, limbs, etc.).

It makes removal of tumors attainable with a simple excision without grafting or other special surgical techniques. In areas with sufficient amounts of skin, this surgical technique is beneficial as it requires less operatory and anesthesia time, and yields more cosmetic results (**Figures 2a-2c**).

The types of tumors that can be removed with the small opening technique are follicular tumors (trichoepitheliomas, infundibular keratinizing acanthomas, trichoblastomas and pilomatrixomas), nevi and hamartomas, lipomas and so on. Locations where this technique is especially advantageous are the legs, pinna, tail, digits, nose, face and eyelids.

Surgical Case Examples

Case 1: As an example of skin tumor laser excision via a small opening, note the lipoma removal on the foreleg of a 7-year-old pit bull mix (**Figures 3a-3e**).

First, an oval 2.5 x 0.5 cm incision was made with the flexible fiber waveguide CO_2 laser. Note in Figures **3b** and **3c** that the elasticity of the skin made the actual opening large enough to remove the tumor. After that, the laser was used to gradually work around the lipoma to free it from the surrounding subcutaneous attachments.

The hemostasis achieved by the laser provided good visibility. There is often adipose tissue around the tumors. The CO_2 laser evaporates it, which exposes the margins between the tumor and the surrounding healthy tissue and allows the surgeon to separate them easier. It is necessary to have one or two assistants to apply traction to the tumor and the normal tissue (**Figure 3c**) as the surgeon directs the laser beam separating the tumor from adjacent tissue.

Note in **Figures 3b-3d** that the long narrow piece of skin on top of the tumor shows the actual amount of skin that was removed to excise this tumor. The lipoma in **Figure 3a** prior to surgery was approximately 5.5 x 3 cm, the incision required to remove this tumor was only 2.5 x 0.5 cm (as indicated by the size of the strip of skin on top of the tumor in **Figure 3b**).

Case 2: One of the most common nodular skin tumors in dogs is the follicular tumor. These have a cystic structure and contain keratin and sebaceous material. Figures **4a-4c** demonstrate the excision of a trichoblastoma in a 5-year-old Labrador retriever.

In **Figure 4a**, note the subcutaneous swelling in the tissues adjacent to the lesion; this swelling delineates the extent of the tumor under the skin. A laser incision was made well inside the borders of the tumor and the entire tumor was later removed via this small opening. During the surgery, the contents of the tumor leaked (see yellowish, caseous material **Figure 4b**. In such cases, the solution is to press gently on the tumor and express the contents out onto the surrounding skin while an assistant wipes the area with saline-soaked gauze to keep the surgical field clean.

In this case, once the tumor contents were removed, the tumor was reduced in size and it was easier for the surgeon to take out (**Figure 4c**).

Case 3: Series of **Figures 5a-5c** shows the CO_2 laser excision of a follicular hamartoma in a 6-year-old Havanese dog. The incision was approximately one-third the actual size of the lesion (**Figures 5b-5c**). Note the hemostasis created by the CO_2 laser and excellent visibility of the surgical field. No sutures were

FIGURE 1: The black lines denote the normal incision lines with traditional scalpel surgery.

FIGURE 2A: Fibro-adnexal hamartoma, present for over 2 years, caused the dog great discomfort, lameness, and bleeding when the dog chewed at the lesions. Amputation of the digits was recommended.

FIGURE 2B: Immediately post-surgical view. Enough skin was preserved for suturing.

FIGURE 2C: 4 weeks post-surgical removal of lesions. CO_2 laser excision resulted in normal paws.

FIGURE 3A: Large lipoma on foreleg, using the CO_2 laser the incision.

FIGURE 3B: The elasticity of the skin allows removal of a large mass through a very small opening. The strip of skin on top of the tumor is the size of the incision made by the CO_2 laser to remove the tumor.

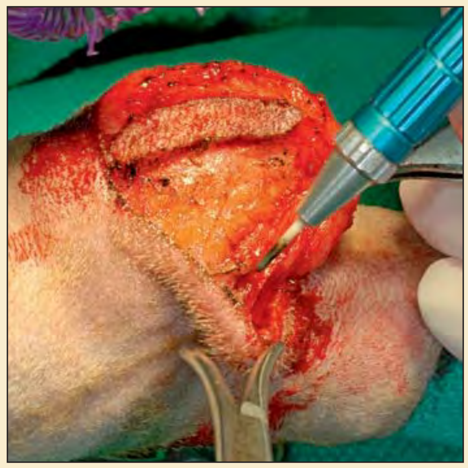

FIGURE 3C: Lipoma separated from subcutaneous attachments with the Aesculight CO_2 laser handpiece.

FIGURE 3D: Excised lipoma with a narrow strip of skin removed during the surgery.

FIGURE 3E: Removal of a large tumor only required a small skin incision. Enough skin was preserved for closure.

required and the surgical site was left to heal by second intention (**Figure 5c**).

Potential Complications

Because the small capillaries are sealed along the surgical incision there is a slight delay in wound healing of laser incisions, so suture removal (if sutures were required) should be done at three weeks post-operatively instead of 10 to 14 days.

Large tumors will leave a space once removed, so measures to prevent seromas need to be taken, such as drain placement and pressure wraps. Also, as with any surgical procedure, the site needs to be protected from damage, so pressure bandages on the surgical site and restriction of exercise are required as needed.

There is potential for re-growth of the tumor if all of the neoplastic tissue is not removed. This rarely happens, and with experience the surgeon will be able to ensure complete removal at the time of the surgery.

Conclusions

The CO_2 laser gives the surgeon the opportunity to make smaller, precise incisions from which to remove tumors with enough skin preserved to close the incision without grafting or significant movement restriction in the patient. Other advantages are less surgery and anesthesia time, as well as great esthetic outcomes.

The CO_2 laser technique discussed in this article helps to ensure the successful removal of challenging tumors that would have been either extremely difficult or impossible to achieve with a traditional scalpel surgery. ●

This Education Center article was underwritten by Aesculight of Woodinville, Wash., manufacturer of the only American-make CO_2 laser.

David D. Duclos, DVM, Dipl. ACVD, is a small-animal practitioner from Lynnwood, Wash., where he has been the owner and clinical dermatologist at the Animal Skin and Allergy Clinic since 1991. He completed his residency in veterinary dermatology at the University of Pennsylvania. He also teaches veterinary students from WSU and from Western University Health Sciences-Veterinary School, Pomona, Calif.

FIGURE 4A: A trichoblastoma – initial incision with the Aesculight tipless CO_2 laser handpiece is placed within the borders of the tumor and does not include the swollen subcutaneous tissues adjacent to the visible lesion.

FIGURE 4B: The contents of the trichoblastoma leaked during the surgery. They were expressed onto the skin around the incision.

FIGURE 4C: Diminished in size, the trichoblastoma was easily removed.

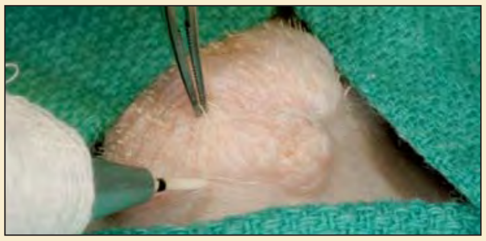

FIGURE 5A: A follicular hamartoma in a 6-year-old Havanese.

FIGURE 5B: Intraoperative view. The incision was placed within the borders of the lesion.

FIGURE 5C: Immediately post-surgical view. No sutures were required.

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Level 1 Procedures	Number Cases/Week	Level 1 Fee ($25 - $50)	Weekly Revenue (cases x fee)
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Lumps & Bumps, Skin Tags			
Level 2 Procedures	**Number Cases/Week**	**Level 2 Fee ($50 - $100)**	**Weekly Revenue (cases x fee)**
Growths & Tumors			
Ears, Redundant Tissue			
Eyes (entropion, cherry eye, etc.)			
Level 3 Procedures	**Number Cases/Week**	**Level 3 Fee ($75 - $120)**	**Weekly Revenue (cases x fee)**
Orthopedic SX			
Anal Glands/Fistulas			
Stenotic Nares/Soft Palate			

Total Weekly Revenue (sum of Levels 1, 2, 3)
Yearly Revenue (Weekly x 50)
Expected Client Compliance (70% avg.)
Weighed Total (Yearly x Compliance)

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