A special advertising section

Surgical CO_2 laser demystified

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

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.

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**.

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.

Figure 4a. Adjustable spot size tipless handpiece

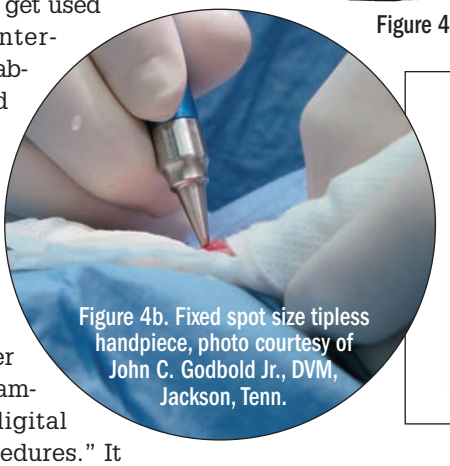


Figure 4b. Fixed spot size tipless handpiece, photo courtesy of John C. Godbold Jr., DVM, Jackson, Tenn.

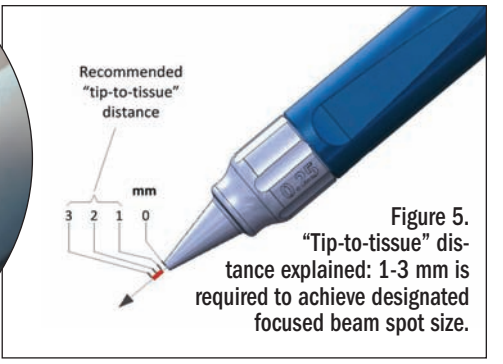


Figure 5. "Tip-to-tissue" distance explained: 1-3 mm is required to achieve designated focused beam spot size.

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.

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.

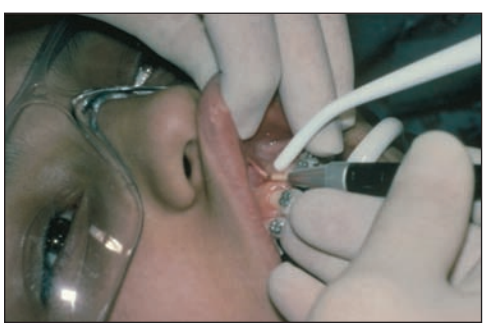
Laser handpiece: Disposable-free "tipless" veterinary handpieces are designed to closely simulate the scalpel experience without making any contact with the tissue. Maintaining 1-3 mm distance between the distal end of the handpiece and the tissue (**Figure 5**) is required to achieve the designated 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**

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.



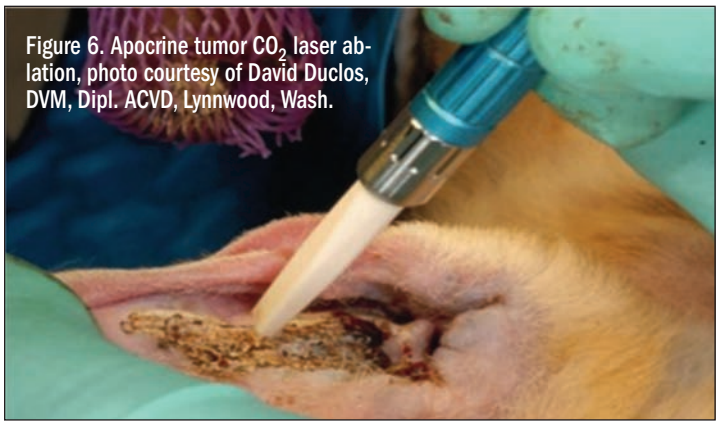


Figure 6. Apocrine tumor CO_2 laser ablation, photo courtesy of David Duclos, DVM, Dipl. ACVD, Lynnwood, Wash.

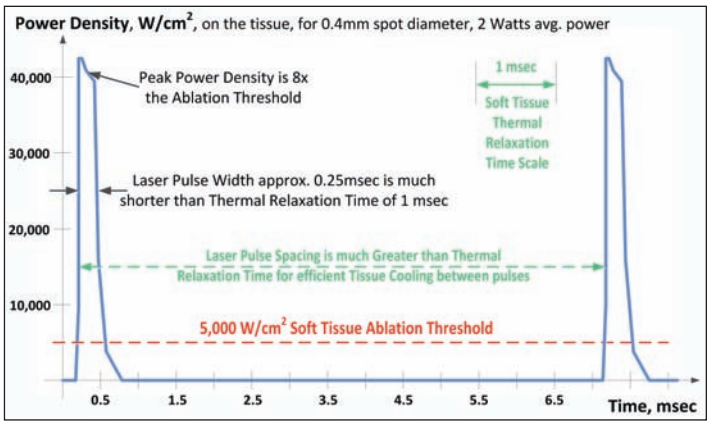


Figure 8. SuperPulse explained: High power, short laser pulses maximize soft tissue removal rate and keep adjacent tissue cool.

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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