Use of carbon dioxide laser for onychectomy in cats

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Objective—To compare postoperative signs of discomfort and complications associated with use of CO_2 laser for onychectomy with those of the scalpel technique in cats.

Design—Prospective, randomized, masked clinical trial.

Animals—20 client-owned cats.

Procedure—Forelimb feet (right, left) were randomly assigned to laser and scalpel treatment groups. Signs of discomfort (lameness and signs of pain) and complications (hemorrhage, swelling, and discharge) were assessed on days 0, 1, and 7. Surgeries were performed by 1 experienced surgeon. Evaluations were performed by 2 individuals without knowledge of treatment group. Signs of discomfort and complications were scored on scales of 0 to 8 and 0 to 9, respectively.

Results—Onychectomy did not result in high discomfort or complication scores 1 day after surgery, regardless of technique used, although the laser-treated group had significantly lower scores for signs of discomfort and complications. Seven days after surgery, significant differences were not detected between groups for signs of discomfort or complications.

Conclusions and Clinical Relevance—The CO_2 laser can be an excellent tool for onychectomy in cats, with excellent hemostasis and minimal postoperative discomfort and complications. Differences in discomfort and complications between groups treated via scalpel versus CO_2 laser were not clinically relevant and were only observed 1 day after surgery. (*J Am Vet Med Assoc* 2002;221:651–653)

The use of lasers in veterinary surgery has increased in recent years. Laser equipment designed for human medical and surgical applications can be recycled for veterinary use, whereas other units are made specifically for veterinary applications at prices affordable to veterinary practitioners. This increase in availability of surgical laser instruments has made their use more cost-effective and practical. Anecdotal reports of the use of surgical lasers in the veterinary literature have been associated with mostly positive outcomes.[1-4] Veterinarians should be aware of surgical procedures for which the use of a laser may be indicated. In addition to understanding the indications for and techniques of laser surgery, veterinarians must know the limitations and benefits of laser use, compared with conventional surgical techniques.

A laser (light amplification by stimulated emission of radiation) is an intense beam of light that delivers a large amount of energy that can be focused into an extremely small spot, permitting precise surgical incisions to be made without the instrument itself touching the tissues. During surgery, this energy is converted into heat that exerts specific effects on tissues.[1] Several different types of lasers are used in surgery, and the CO_2 laser is most commonly used in small animals. The CO_2 laser instantly heats intracellular water above boiling point, thereby vaporizing or ablating targeted cells. The vaporization is rapid and precise, causing minimal thermal damage to surrounding tissues. As the laser makes an incision, small blood vessels are sealed by tissue contraction, resulting in decreased hemorrhage at the surgery site.[2] Additionally, nerve endings and lymphatic vessels are sealed, with resultant decreased pain sensation and less postoperative swelling.[2] In addition, the laser can vaporize tissues and bacteria and create a cleaner surgical site.[3] The CO_2 laser has been used in a variety of soft tissue procedures including tumor removal (cutaneous, oral, ophthalmic), ear ablations, de-barking procedures, and soft palate resection.[2,3] Onychectomy procedures have become 1 of the more common surgical procedures performed with a laser because of the reported advantages of decreased hemorrhage, swelling, and signs of pain.[4] Anecdotal reports from veterinarians who have used the laser for onychectomy claim that the recovery period is substantially less than with scalpel techniques.[1-4] Scientific investigation of these claims is needed to determine whether laser onychectomy is practical and superior to conventional surgical techniques.

Studies regarding conventional surgical techniques for onychectomy in cats have investigated the degree of postoperative pain, the effect of various analgesics and anesthetics, and the type of procedure performed.[5-10,a] Early postoperative pain was more common after use of a blade than after use of a nail clipper for onychectomy,[11] but late postoperative complications were more common when nail clippers were used.[11]

The purpose of the study reported here was to compare the use of CO_2 laser with the scalpel technique for onychectomy with regard to postoperative signs of discomfort and complications; we hypothesized that there was no difference between the 2 techniques.

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Materials and Methods

Cats—The All-University Committee on Animal Use and Care approved the study design. Twenty client-owned cats were admitted to the Michigan State University Veterinary Teaching Hospital. Informed consent was obtained for each cat in the study. Baseline data were obtained that included history, results of physical examination, PCV, and total solids. Inclusion criteria were that cats were healthy as judged on the basis of history and physical examination findings and were admitted for elective forelimb onychectomy. Cats were of any age, breed, or sex. Cats were excluded from the study if they had any concurrent disease, inadequate vaccination status, PCV or total solids values that were not in reference ranges, or if they were given any perioperative medications other than those prescribed by the standard operating procedure for anesthesia. The cats were also excluded if their owners did not return them for the 7-day recheck appointment.

Anesthesia—All cats were administered morphine sulfate[b] (0.66 mg/kg [0.3 mg/lb], IM) for preemptive analgesia and acepromazine maleate[c] (0.11 mg/kg [0.05 mg/lb, IM]) 20 minutes prior to induction of anesthesia. Anesthesia was induced with 2.5% thiopental sodium[d] administered IV with an initial bolus of 6.6 mg/kg (3.0 mg/lb). An orotracheal tube was placed, and anesthesia was maintained by administering isoflurane in oxygen with a semiclosed anesthetic system. Physiologic variables (heart and pulse rates, respiratory rate, oxygen saturation, and indirect blood pressure) were monitored during anesthesia. After completion of the procedure, the cats were observed in recovery until they were able to maintain sternal recumbency without assistance. Analgesics were not administered to any of the cats after surgery.

Surgery—All onychectomy procedures were performed by 1 experienced surgeon (JH). Each foot was scrubbed routinely with 2% chlorhexidine gluconate solution and saline (0.9% NaCl) solution. The cat was brought into the operating room and placed in left lateral recumbency. A Penrose drain tourniquet was placed on the antebrachium just distal to the right elbow joint. The right foot was draped routinely. Onychectomy was performed first on the right foot regardless of the surgical technique used. Allocation of laser or scalpel technique to the right or left foot was based on the result of a coin toss. For both techniques, the skin was incised around the entire claw, within 2 mm of the skin-claw junction. The soft tissues, joint capsule, collateral ligaments, and tendons were incised, separating the third phalanx from the second phalanx. The same procedure was performed on all 5 digits of the right foot. The wounds were swabbed with a saline solution-moistened dressing as recommended after laser surgery.[e] Two drops of glue (n-butyl cyanoacrylate tissue adhesive)[f] were placed in each wound, the wound was squeezed shut from lateral to medial and from proximal to distal, and the wound was held for 5 seconds. The same procedure was performed on the left foot with the alternate technique (laser or scalpel). The feet were not bandaged after surgery.

Postoperative assessment—Discomfort and complications were assessed on day 0 (before surgery), 1, and 7 by 2 individuals who were unaware of treatment group. For each foot, discomfort was assessed by means of a combination score (0 to 8) on the basis of the sum of lameness (0 to 4) and pain (0 to 4) scores. Similarly, complications were assessed by means of a combination score (0 to 9) based on the sum of swelling (0 to 3), hemorrhage (0 to 3), and discharge scores (0 to 3; **Appendix**).

Statistical analysis—The paired observations of laser versus scalpel discomfort and complication scores (mean ± SEM) at postoperative days 1 and 7 were analyzed by use of the Wilcoxon signed-rank test. A 3-factor ANOVA was used to calculate variances attributable to the random factors of cat and observer. **Repeatability (r)** of the observer measurements was calculated from the variances (σ^2) by means of intraclass correlation ($r = \sigma^2_{cat}/[\sigma^2_{cat} + \sigma^2_{obs}]$). For all comparisons, a value of $P < 0.05$ was considered significant.

Results

Twenty consecutively evaluated cats were included in the study (10 males and 10 females). Mean ± SEM age of the cats was 14.3 ± 4.0 months. Fifteen cats were young (< 9 months) and small (< 3.6 kg [8 lb]), whereas the other 5 cats were older and larger. Preoperative (day 0) discomfort and complication scores were minimal (discomfort, 0.2 ± 0.1; complications, 0). Mean ± SEM surgery time for laser onychectomy was 9.0 ± 0.5 minutes and for scalpel onychectomy was 7.6 ± 0.5 minutes. All cats recovered from anesthesia without any complications. One day after surgery, the onychectomy procedures did not result in high discomfort scores (laser, 1.1 ± 0.1; scalpel, 1.8 ± 0.2; $P = 0.002$) or complication scores (laser, 0.8 ± 0.1; scalpel, 1.3 ± 0.2; $P = 0.03$) regardless of the technique used, although differences between the treatment groups were significant. One day after surgery, repeatability of the observer discomfort measurements was 72%, whereas repeatability of the observer complication measurements was 100%. There were no differences between the 2 techniques with regards to discomfort (laser, 1.4 ± 0.3; scalpel, 1.2 ± 0.1; $P = 0.8$) or complications (laser, 1.2 ± 0.2; scalpel, 1.1 ± 0.2; $P = 0.26$) 7 days after surgery.

Discussion

Onychectomy is a common surgical procedure performed in small animal practice. It is usually performed to prevent cats from scratching furniture or people, and generally only the forelimb claws are removed. Onychectomy may also be indicated in the treatment of paronychia (onychomycosis or follicular infections) and nailbed neoplasms (squamous cell carcinoma, melanoma, soft tissue sarcoma, and osteosarcoma).[12] The surgery is commonly performed with a scalpel or guillotine-type nail clipper. Common complications seen after onychectomy include hemorrhage, swelling, and signs of pain. Other complications include pad damage, lameness, infection, claw regrowth, and protrusion of the second phalanx.

Results of this study indicated that onychectomy can be effectively performed with a CO_2 laser. It was subjectively observed during the study that the laser provided excellent intraoperative hemostasis and a clean and dry surgical field. As observed in this study, onychectomy performed by use of either the laser or scalpel technique did not result in signs of a great deal of discomfort or substantial complications. The laser technique did, however, result in lower discomfort and complication scores on the first postoperative day, although the subtle difference between the 2 techniques may be difficult to detect clinically. In our study, the difference between the techniques did not seem clinically important.

[a]Robertson SA, Richter M, Martinez S. Comparison of two injectable anesthetic regimens for onychectomy in cats (abstr). *Vet Surg* 1996;25:186.

[b]Morphine sulfate, Ekins Sinn Inc, Cherry Hill, NJ.

[c]Acepromazine maleate, Fort Dodge Animal Health, Fort Dodge, Iowa.
[d]2.5% thiopental sodium, Abbot Laboratories, North Chicago, Ill.
[e]AccuVet Laser Surgery Manual, Lumenis, Needham, Mass.
[f]Vetbond (n-butyl cyanoacrylate tissue adhesive), 3M Animal Care Products, St Paul, Minn.

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Appendix

Scoring system used for assessment of signs of discomfort and complications after onychectomy in cats

Lameness score	Criteria
0	No lameness
1	Occasionally holds foot up, barely perceptible lameness on ambulation
2	Obvious lameness, will bear weight
3	Will occasionally touch digit to ground
4	No weight bearing

Pain score	Criteria
0	No pain
1	Resists firm touching—allows handling of foot, but will retract it
2	Resists moderate touching—initially allows handling of foot, but vigorously retracts foot
3	Resists mild touching—objects to handling of foot
4	Resists any touching

Swelling score	Criteria
0	No swelling
1	Minimal swelling, 1 or more digits
2	Moderate swelling
3	Severe swelling, all digits

Hemorrhage score	Criteria
0	No hemorrhage
1	Mild spotting of blood on foot or cage
2	Moderate hemorrhage that requires observation, possibly bandaging
3	Severe hemorrhage on walls of cage and cat, requiring bandaging

Discharge score	Criteria
0	No discharge
1	Mild discharge, 1 digit
2	Copious discharge from 1 digit or mild-to-moderate discharge from > 1 digit
3	Copious discharge from > 1 digit