

Case Series

Low Level Laser Therapy Combined with Laser Acupuncture for Treatment of Non-Healing and Multidrug-Resistant Wounds in Five Dogs: A Case Series

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ABSTRACT

This is a case series study of 5 canine patients who received low level laser therapy (LLLT) combined with laser acupuncture (LAP) treatment for non-healing wounds resulting from traumatic or surgical site infections. Although treated appropriately with conventional wound interventions, spanning 1–16 weeks, all patients experienced suture dehiscence along with bacterial contamination. Aerobic wound cultures included *Staphylococcus pseudintermedius*, *Pseudomonas aeruginosa*, and methicillin-resistant *Staphylococcus aureus* (MRSA); all of which had failed intense antibiotic therapy at the referring clinic. Laser therapy was initiated to resolve the non-healing wounds, with concurrent discontinuation of antibiotics and anti-inflammatory pharmaceuticals. The protocol included laser acupuncture (LAP) applied to acupoints using Reninger Meridian or Bahr 5 frequencies for 30 seconds (2–5 J total), combined with LLLT delivered across the entire wound surface (Nogier A" frequency, 10 J/cm²). Sessions were typically performed twice weekly initially and then tapered as clinical improvement occurred. Following 2–5 weeks of laser therapy, local wound infections resolved in all five cases, after which normal wound healing progressed. This case series suggests that combined laser therapy (LAP and LLLT) may exert antibacterial effects and provide therapeutic benefit in the management of chronic, non-healing skin wounds in dogs.

Keywords: acupuncture, canine, laser, MRSA, multidrug-resistant bacteria, non-healing wound

ABBREVIATIONS: LLLT: low level laser therapy; MDR: multidrug-resistance; MRSA: methicillin-resistant *Staphylococcus aureus*; mW: milliwatt; NSAID: non-steroidal anti-inflammatory drug; PBMT: photobiomodulation therapy; W: watt

A non-healing wound is defined as a wound that fails to progress through the normal healing stages with standard wound care.¹ Non-healing wounds are a clinical problem in veterinary medicine leading to serious complications, which include infection, widespread tissue damage with poor cosmetic results, and sometimes amputation or euthanasia.¹ Added to the problem of tissue infection is the further complication of antimicrobial resistance, which is a growing threat in the 21st century.² According to World Health Organization estimates (as of 2025), there are 1.3 million people that die each year due to antibiotic resistant infections.³ The European Centre for Disease Prevention and Control (ECDC) recently reported that more than 35,000 people die each year in the European Economic Area (EEA) due to antibiotic resistance. In Germany alone, up to 600,000 people fall ill from resistant bacterial infections each year, and around 15,000 die as a result.^{3,4}

In veterinary hospitals, there has also been increasing recognition of the growing prevalence of multidrug-resistant (MDR) infections with increased patient

hospitalization lengths, delayed recoveries, and increased morbidity and mortality rates.² A recent retrospective study using 80 dogs with positive aerobic cultures associated with traumatic wound or surgical site infection, identified 19 dogs with MDR infections. The implications for patient outcomes included 11.8 times higher increased risk of death in affected individuals, while total medical costs were 3.57 times greater. Additionally, the duration of hospitalization was nearly three times longer. Key risk factors for these infections included steroid use within the past year, the use of NSAIDs or steroids within one week before culture, and use of penicillin or clindamycin within 3 months before culture.²

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Therapeutic laser usage, termed photobiomodulation therapy (PBMT), continues to gain popularity in veterinary medicine as a non-invasive, drug-free treatment used to treat pain, inflammation and dysfunction for a variety of conditions (e.g. musculoskeletal injuries, arthritis, neurological deficits). Additionally, investigations have begun to highlight its benefit for treatment of skin trauma in dogs, documenting faster incision healing, better cosmetic results, and a significant reduction in bacterial presence and wound size when used.^{1,5,6}

Low level laser therapy (LLLT) and laser acupuncture (laser stimulation of acupoints, LAP) are a subset of PBMT which is the use of red and near-infrared light to stimulate healing, relieve pain and reduce inflammation.^{6,7} The mechanism of action involves mitochondrial photoreception, which leads to enhanced cellular metabolism, increased ATP production, modulation of inflammatory mediators, and analgesic effects.^{1,6,7} Bacterial proliferation in wounds can negatively affect healing and the use of LLLT and LAP deserve special attention for treatment of MDR infections where pharmaceutical use lacks efficacy.

Although there are large numbers of studies listed in PubMed on promoting wound healing through laser therapy, these are primarily animal model and *in vitro* skin studies.⁸ There are far fewer studies evaluating clinical use in dogs.^{7,9} In addition, most studies use laser therapy as an adjunct therapy and combine it with stem cells (fat, marrow), nanoparticles, or other therapies. About fifteen studies deal with laser therapy for MRSA-infected wounds in animal models.⁸ Here, too, laser light is only used in combination with the above-mentioned therapies and, in some studies, with ozone therapy.^{10,11} In a literature review, clinical studies that documented a complete cure of MRSA infections, even in the context of combination therapy were not found by the author.

In the present case series, a retrospective evaluation of canine non-healing wound cases treated with a combination of LLLT and LAP by the author were collected. The objective of the case series was to evaluate the results of dogs with non-healing wounds, infected

with MRSA or MDR pathogens that were treated with laser therapy after failure of conventional therapies in the author's clinical practice.

MATERIALS AND METHODS

Subjects

Five dogs with non-healing wounds were selected from the author's clinic cases. Each subject had a history of impaired postsurgical healing lasting between 1 week and 4 months despite standard therapeutic intervention. In all cases, the initial postsurgical treatment was unsuccessful due to surgical incision necrosis and infections that could not be controlled with antibiotics (Table 1). Two patients cultured positive for methicillin-resistant *Staphylococcus aureus* (MRSA) infection, 1 had *Pseudomonas aeruginosa*, 1 had *Staphylococcus pseudintermedius* and 1 had a chronically infected wound unresponsive to antibiotics but no culture results were reported. All patients exhibited delayed or impaired wound healing accompanied by poorly controlled pain, with several cases demonstrating a grave prognosis and low likelihood of responding favorably to treatment.

Laser Treatment

Prior to initiation of combined LLLT and LAP treatment, wounds were thoroughly flushed with a mild disinfectant solution (0.1% ethacridine lactate)^a or sterile water. The wounds were left uncovered, with the exception of Case 5, in which a sterile gauze dressing secured with a bandage was applied. Following thorough cleaning of wounds, the surface was irradiated locally using a 904 nm, 90 W pulsed laser^b, spot size 8 mm², for 1-5 minutes (30 sec per 1 cm² of wound surface, Nogier A" frequency) delivering an energy density of 5 J/cm². Treatment was performed in non-contact mode, with the laser held as close as possible to the wound surface and the probe covered with a thin layer of cling wrap to maintain cleanliness. The Nogier A" frequency was selected for LLLT due to its reported high anti-inflammatory effects (Table 2).

Table 1: Summary of signalment, wound size/chronicity, bacterial culture and antibiotics used for case series dogs affected with a non-healing wound.

Case	Gender (age)	BW (kg)	Breed	Wound (Traumatic, Surgical Site)	Wound Age	Bacterial Culture (Sensitivity/Resistance)	Antibiotics Used Prior to Laser Treatment
1	Male (12 yr)	9	West Highland Terrier	Traumatic, 19 cm bite and tear injury encircling 2/3 of neck	1 week	No culture	Unable to locate information
2	Male (3 yr)	28	German Shepherd mix	Traumatic, bite dorsal back, 12 cm	4 months	<i>Pseudomonas aeruginosa</i> (not sensitive to tested antibiotics)	Cefquinome, Enrofloxacin, Marbofloxacin
3	Spayed Female (8 yr)	31	White German Shepherd	Surgical site, removal of mammary tumor 25 cm wound	3 months	MRSA (not sensitive to tested antibiotics)	Trimethoprim Sulfonamide, Amoxicillin Clavulanic acid
4	Neutered Male (3 yr)	42	Bernese Mountain dog	Surgical site, castration 20 cm wound	2 months	MRSA (not sensitive to tested antibiotics)	Doxycycline, Rifamycin (others)
5	Male (5 yr)	40	Doberman Pinscher	Surgical site, removal of mast cell tumor, inguinal area, 12 cm wound	5 weeks	<i>Staphylococcus pseudintermedius</i> (not sensitive to tested antibiotics)	Rifampicin, Doxycycline (others)

Table 2: Summary of low level laser therapy (LLLT) parameters and wound treatment course for case series dogs, including LLLT treatment area, energy density (J/cm²), frequency settings, total energy delivered per wound, and total number of treatments.

#	Area of LLLT Tm	Total Time LLLT Tm	Joules/cm ²	Total Joule Dose per Wound	Laser Frequency Setting	Total Number of Laser Treatments (Total Duration of Tm)
Case 1	100 cm ²	5 min	5 J/cm ²	500 J	Nogier A" (37376 Hz)	4 Tm total (16 days) LAP and LLLT
Case 2	50 cm ²	3 min	5 J/cm ²	250 J	Nogier A" (37376 Hz)	9 Tm (4 wks) LAP and LLLT
Case 3	50 cm ²	3 min	5 J/cm ²	250 J	Nogier A" (37376 Hz)	5 Tm at clinic, 10 Tm at home (5 wks) LAP and LLLT
Case 4	50 cm ²	3 min	5 J/cm ²	250 J	Nogier A" (37376 Hz)	3 Tm at clinic, 12 Tm at home (3 wks) LAP and LLLT
Case 5	50 cm ²	3 min	5 J/cm ²	250 J	Nogier A" (37376 Hz)	7 Tm at clinic (5 wks) LAP and LLLT

Tm=treatment; mins=minutes; wks=weeks

Following wound surface treatment, LAP was performed on selected acupuncture points which were irradiated for 30 seconds per point. Frequencies and acupoints used included SP-2 (Reninger Spleen Meridian, 0.7 J/min), SP-4 (Bahr 5, 10 J/min), TH-5 (Bahr 5, 10 J/min), and GB-41 (Bahr 5, 10 J/min). These acupoints were chosen for their immune stimulation effects (particularly SP-4, TH-5) along with anti-inflammatory actions to support wound healing (Table 3). Bahr 5 was used as a special frequency for all "Opening Points," rather than using individual Meridian frequencies.

Treatments were typically performed twice weekly at the clinic and then tapered as clinical improvement occurred. In select cases, owners administered interim treatments at home using a 90 W super-pulsed (Class IIIb) laser provided by the clinic. Owners were provided with detailed instructions, including a standardized treatment protocol specifying acupoints, frequencies, and application times, along with an anatomical map for point localization. Additionally, acupoints were marked on the patient's skin to facilitate accurate application of treatments by owners.

Table 3: Acupuncture points selected for laser acupuncture treatment of non-healing wounds with laser frequency setting used, period of time irradiated with joules per minute, and reason for use with actions

Acupoint	Laser Frequency Setting	Joules per Minute	Reason for Acupoint Use and Actions
SP-2	Reninger-Spleen Meridian 30 seconds	0.7	Tonifying point of the Spleen (Master point for building energy/tissue regeneration)
SP-4	Bahr 5 30 seconds	10	Opening point (Master point treats infection), Interferon point
TH-5	Bahr 5 30 seconds	10	Opening point (Master point for tissue demarcation/necrosis), Thymus point
GB-41	Bahr 5 30 seconds	10	Opening point (Master point treats degenerative inflammation), Prostaglandin point

Antibiotic and pharmaceutical analgesic therapies were discontinued upon initiation of laser therapy. Given the lack of clinical response to these medications over weeks to months, continuation was not warranted, particularly in light of their potential to interfere with treatment response. In addition, this approach aligns with principles of antibiotic stewardship, which discourage continued use when a therapy has proven ineffective against the target infection.

RESULTS

Clinical Case 1

A 12-year-old intact male West Highland Terrier sustained a 19 cm bite and tear injury involving approximately two-thirds of the circumference of the neck (Figure 1). Initial management by the referring veterinarian included wound freshening followed by primary closure, administration of antibiotics and LLLT using a low-power cluster laser^c (14-diode, 50 mW continuous wave). Despite this treatment, the sutured wound edges developed necrosis with subsequent dehiscence, resulting in a large gaping defect.

When the dog presented to the author's clinic after one week of treatment, the only viable tissue remaining was an approximately 11 cm ventral cervical skin bridge, with the dorsal wound measuring up to 15 cm at its widest point. Following wound cleaning and initiation of LLLT, all medications, including antibiotics and analgesics, were discontinued. This decision was based on the author's clinical experience that LLLT combined with LAP provides effective analgesic and sustained anti-inflammatory control. The wound was not re-sutured. In addition to LLLT, acupuncture points targeting wound healing and inflammation were treated (Tables 2 and 3). Over a 16-day period, the patient received four treatments (two per week). Estimated wound closure progressed from approximately 10% at Day 3, to 30% at 1 week, 60% at Day 10, and nearly complete closure by Day 16. The dog exhibited minimal pain throughout the treatment period (Figure 2).



Figure 1 (left): Case 1 with complete wound edge necrosis (white arrow), 10 days after surgery to repair a bite wound (head on the top left in a transparent neck collar). **Figure 2** (right): Case 1—The patient's head held between hands showing the healed wound site after a total of 16 days and 4 treatment sessions (arrows).

Clinical Case 2

A 3-year-old intact male German Shepherd mix was presented for evaluation after 4 months of unsuccessful treatment of a bite wound, with prior recommendation for discontinuation of care due to poor prognosis and persistent pain. Wound culture performed at the referring clinic confirmed infection with multidrug-resistant *Pseudomonas aeruginosa*.

When initially examined by the author, the wound was characterized as a highly destructive, infiltrative infection. It consisted of a chronic, non-healing 12 cm linear bite wound located on the dorsal right shoulder, oriented parallel to the vertebral spinous processes (Figure 3). The granulation tissue contained multiple fistulous tracts with marked secretory activity. Initial treatment was begun with thorough wound cleaning/flushing and discontinuation of antibiotics and analgesics. This was followed by laser therapy (LLLT, LAP) (Tables 2 and 3).

After 10 days of treatment administered every two days (five total sessions), the wound demonstrated clear progression toward healing, with healthier tissue, epithelialization at wound edges, a well-developed granulation bed, and early contraction (Figure 4). Wound size decreased by approximately 10% between successive evaluations prior to each treatment session. Pain improved rapidly, with substantial relief noted after the first treatment and an estimated 80% reduction by Day 2, coinciding with resolution of inflammation and transition to more normal stages of wound healing. As clinical improvement stabilized, treatment intervals were extended to every 10 days, with the final session performed at the 1-month recheck. By one month after initiation of laser therapy, the wound had achieved approximately 95% closure with a satisfactory cosmetic outcome, characterized by only a thin residual scar (Figure 5).



Figure 3: Case 2—Initial presentation of a 12 cm chronic non-healing bite wound located parallel to the dorsal spinous processes over the right shoulder.



Figure 4: Case 2—This photograph shows the dorsal right shoulder of the patient presented for treatment in Figure 3 after 10 days (5 treatments) of LAP and LLLT. There is significant wound contraction (9 cm) and production of a healthy bed of granulation tissue bordered by a small edge of normal epithelia with no evidence of infection.



Figure 5: Case 2—This photograph shows the infiltrative inflammatory skin lesion presented in Figure 3 completely healed after 1 month of treatment without aid of further surgery and antibiotics.

Clinical Case 3

An 8-year-old spayed female white German Shepherd presented 3 months after surgical removal of a mammary gland tumor complicated by a MRSA surgical site infection. Despite multiple antibiotic regimens, the infection persisted, prompting revision surgery. Within 3 days of surgical revision, persistent wound sepsis resulted in complete suture dehiscence of the 25 cm wound. Marked inflammation of the surgical site was evident, with edema and erythema extending up to 10 cm beyond the wound margins, accompanied by multiple fistulous tracts (Figure 6).

Following failure of these intensive therapies to achieve clinical improvement, the dog was assigned a grave prognosis, and discontinuation of care was recommended due to ongoing pain and lesion progression. Upon presentation to the author's clinic, a treatment protocol consistent with that used in the other cases was initiated. The wound was cleaned and flushed, and laser therapy

(LAP, LLLT) was started, with concurrent discontinuation of antibiotics and analgesics. Treatment parameters were consistent with those used in previous patients, with LLLT applied at the anti-inflammatory Nogier A" frequency and selected acupuncture points used to support immune function (e.g. TH-5, SP-4) in combination with acupoints providing anti-inflammatory actions (Table 3).

Clinic-based therapy was performed over three visits at 1-2 weeks intervals. Between visits, the owner administered daily treatments using a clinic-provided laser, following the same protocol used during in-clinic sessions. At the second visit, one week after initiation, pain was minimal, with an approximately 50% reduction in inflammation, apparent resolution of infection, and clear progression to a healthy wound-healing phase. At each subsequent visit, wound size decreased by roughly 50% relative to the previous assessment. After five weeks of laser therapy, the wound healed without complications (Figure 7).



Figure 6: Case 3—MRSA infection in a white German Shepherd dog after mammary tumor removal. The suture line was erythematous, with dehiscence and fistula formation secondary to sepsis.



Figure 7: Case 3—Appearance of the surgical site wound presented for treatment in Figure 6 after 5 weeks of laser treatment. Note complete wound healing without additional therapy such as antibiotics or analgesics.

Clinical Case 4

Following castration, a 3-year-old male Bernese Mountain dog developed a severe surgical site infection unresponsive to antibiotic therapy and subsequently cultured as methicillin-resistant *Staphylococcus aureus* (MRSA). Combination antimicrobial therapy failed to achieve clinical improvement, and two revision surgeries for debridement did not resolve the condition. Within 3 days of the second surgery, a firm, erythematous swelling (12×5 cm) was noted (Figure 8). Given ongoing lesion progression and pain, the prognosis was considered grave and cessation of treatment was recommended.

Despite the severity of clinical signs, the dog was presented for evaluation for laser therapy. Treatment was initiated with the provision that pain levels would be closely monitored by the owners, with reassessment of the management approach if meaningful clinical improvement was not observed within 48 hours. Treatment management was consistent with the other cases in this series. The wound was cleaned, remaining sutures were left in place, laser therapy (LAP, LLLT) was initiated, and antibiotics with analgesics were discontinued.

During the initial treatment, the dog demonstrated marked pain relief, along with improved mobility and alertness. The owners were instructed in home use of a clinic-provided 90 W laser and asked to report progress the following day. Based on a satisfactory reduction in pain, daily home therapy would be continued. Two days later, the owner reported the remaining sutures had dehiscd, resulting in an open wound, at which point pain was minimal. At the 1-week follow-up, there was a marked reduction in peripheral edema accompanied by an approximate 10% decrease in wound size. Over the 3-week treatment period, the patient received three clinic-based treatments (once weekly) and 12 owner-administered treatments at home. Wound closure progressed gradually during the first week (approximately 10%), then accelerated in subsequent weeks (approximately 50% by Week 2), consistent with transition to an active repair phase, with complete closure achieved by Week 3 (Figure 9).

Clinical Case 5

An intact 5-year-old male Doberman Pinscher developed an extensive surgical site infection involving the inguinal region following removal of a 2 cm mast cell tumor, which was initially managed with wound drainage, irrigation, and antibiotic therapy. Due to lack of clinical improvement after 1 week, a culture and sensitivity test was performed. Microbiological analysis identified *Staphylococcus pseudintermedius* resistant to the antibiotics tested.

Treatment was attempted with combination antimicrobial therapy and surgical debridement of infected tissue. One week following revision surgery, the wound completely dehiscd, prompting a second surgical attempt to remove infected tissue and achieve closure. Despite these interventions, the infection progressed, with recurrent suture dehiscence. The site was subsequently managed as an open wound with daily cleaning and bandaging; however, no progress toward closure was observed.



Figure 8: Case 4—MRSA infection in a Bernese Mountain dog after castration and two revision surgeries.



Figure 9: Case 4—The surgical site wound 3 weeks after initiation of laser treatment (LAP+LLLT) without further medication or other therapies.

Ultimately, the lesion was considered non-healing due to the progressive inflammation and persistent pain, despite 4.5 weeks of intensive therapy.

The dog was presented to the author's clinic for evaluation following a poor/guarded prognosis for recovery, with a 5-week-old wound exhibiting marked inflammation and pain (Figure 10). After assessment, laser therapy (LLLT, LAP) was initiated using the same protocol as in previous cases: twice weekly for 2 weeks, followed by once-weekly treatments. The wound was covered by sterile wound gauze fixed by a bandage. At the first follow-up evaluation (4 days), reductions in swelling, erythema, and pain were observed. With continued therapy, the wound demonstrated progressive healing, with a 50% decrease in size. Increasing tension at the wound site due to stifle flexion, however, resulted in repeated mechanical disruption, leading to recurrent wound breakdown. Attempts at strain relief, including taping, did not result in further improvement after a total of 5 weeks of laser therapy (Figure 11). The dog was subsequently referred to a surgical specialty clinic, where, given resolution of infection and minimal residual inflammation, surgical closure was performed using a skin flap from the abdomen. According to the operating clinic, the graft healed without complications.



Figure 10: Case 5—Pre-treatment image of the right inguinal/stifle area after bandage removal in a Doberman. The area is characterized by a markedly inflamed, painful, antibiotic-resistant *Staphylococcus pseudintermedius* surgical site infection. This region corresponds to the area indicated between the arrows in Figure 11.



Figure 11: Case 5—Healed wound after 5 weeks of laser therapy (LAP + LLLT). In the left image, arrows indicate the original wound margins shown in Figure 10. The right image demonstrates increased tissue tension across the wound site secondary to contracture, which caused discomfort during movement and ultimately necessitated a flap procedure. The delayed healing observed in this case was attributed to a combination of antibiotic-resistant bacterial infection and increased mechanical tension across the flexed stifle.

DISCUSSION

Non-healing wounds represent a persistent clinical challenge in veterinary medicine. Photobiomodulation is a non-invasive, versatile, and well-tolerated treatment modality that has demonstrated benefits in cutaneous wound healing. Its use in the management of skin lesions is increasing among veterinarians; however, clinical evidence remains limited, particularly for chronic wounds complicated by multidrug-resistant infections. In this case series, five patients with non-healing, infected skin wounds, referred to the author's clinic following failure of standard wound management, were treated exclusively with laser

acupuncture in combination with local laser therapy using a 904 nm, 90 W super-pulsed laser^a, applied across a range of frequencies from Reninger Spleen Meridian (702 Hz) to Nogier A" (37,376 Hz).

Across all cases, prior conventional management, including surgery, anti-inflammatory and analgesic medications, along with intensive antibiotic therapy, had not resulted in meaningful clinical improvement. In this series, all five patients demonstrated reduction in wound-associated pain, with subsequent resolution of the non-healing lesions within 3–6 weeks. With the exception of Case 5, treatment with laser therapy alone (LAP, LLLT) resulted in complete wound healing without the need

for additional interventions. In Case 5, resolution of the *Staphylococcus pseudintermedius* infection with laser therapy facilitated subsequent flap reconstruction, which proceeded without complications.

Research has increasingly focused on underlying mechanisms by which laser light promotes skin healing. Specifically, PBMT appears to enhance wound healing through dual mechanisms: optimizing the biological immune response and directly inhibiting bacterial growth.^{1,6} *In vitro* investigation shows it triggers cytokine migration (e.g. IL-1 β , TNF- α , IL-6, MCP-1) and immune cell infiltration, which stimulates the structural phases of healing; from angiogenesis to collagen formation.¹ Beyond host modulation, PBMT exerts a direct antimicrobial effect by targeting endogenous porphyrins within bacteria. When stimulated by laser light, these porphyrins release free radicals that damage cytoplasmic membranes and DNA. Once this damage surpasses the cell's repair capacity, microbial metabolism is inhibited, resulting in a bactericidal or bacteriostatic effect.⁶

This retrospective case series suggests a potential beneficial effect of LLLT combined with LAP in wound healing, particularly in cases involving infection-associated healing complications. Acupuncture and LLLT are separate treatment modalities, but the synthesis of these two very effective therapies allows local healing of diseased tissue with LLLT, combined with acupuncture as an autonomous regulating therapy. Additionally, this series demonstrates the clinical advantages of using a 904 nm laser with 90 W pulse peak power, which provides excellent deep tissue penetration for complex wounds. These pulsed lasers deliver a sufficient density of photons to traumatized tissue to promote cellular repair while avoiding the risk of thermal injury. Furthermore, the ability to apply specific Nogier, Bahr, or Reiningner Meridian frequencies, rather than relying on standard settings (e.g. 600 Hz, 1000 Hz), allows for a more individualized treatment approach based on tissue characteristics, such as active inflammation or high bacterial burden, thereby maintaining resonance with the body's physiological state.

Although favorable outcomes were observed in this case series, the findings should be interpreted in light of several limitations, including the small sample size and heterogeneity of wound presentations. In addition, the use of a single laser system limits generalizability to other devices. This is illustrated by Case 1, in which initial treatment at the referring clinic using a low-power continuous wave laser (50 mW) with alternative parameters failed to produce clinical improvement. As with most retrospective analyses, this study is also subject to inherent limitations, including potential selection and recall bias, confounding variables, and incomplete data due to gaps in medical records or variable owner compliance.

Despite the small sample size and limitations inherent to a retrospective design, this case series suggests that laser therapy may exert antibacterial effects and contribute to improved management of chronic, non-healing skin wounds in dogs. Further evaluation through larger, prospective studies with greater methodological rigor is

warranted, including the use of quantitative outcome measures such as percentage reduction in wound surface area over time and objective pain scoring systems (e.g. Glasgow Composite Pain Scale). Given the rising prevalence and clinical impact of multidrug-resistant infections in modern veterinary medicine, investigation in this area is warranted, including consideration of potential translational applications to human medicine.

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FOOTNOTES

- ^a 2% Rivanol®, Dermapharm AG, Lil-Dagover-Ring 7, 82031 Grünwald, Germany
- ^b Physiolaser Olympic, 90 W/904 nm, super-pulsed laser. Reimers & Janssen, 14057 Berlin, Germany
- ^c MKW Power Plus (14×50 mW, 785 nm, CW laser), MKW Laser System GmbH, 76547 Sinzheim, Germany

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