

Effect of Targeted Pulsed Electromagnetic Field Therapy on Canine Postoperative Hemilaminectomy: A Double-Blind, Randomized, Placebo-Controlled Clinical Trial

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ABSTRACT

Intervertebral disc disease is one of the leading causes of paralysis in dogs. Pulsed electromagnetic field (PEMF) therapy has been advocated for improving wound healing and pain reduction; however, robust clinical trials are lacking. The present prospective, double-blind, placebo-controlled trial evaluated targeted PEMF therapy administered to 53 client-owned dogs who underwent hemilaminectomy for naturally occurring disk extrusion intervertebral disc disease. The dogs were randomized to receive either targeted PEMF ($n = 27$) or placebo treatment ($n = 28$). Wound healing, evaluated by visual analog score and wound evaluation scale, was significantly improved at 6 wk postoperatively in the treatment compared with the control group ($P = .010$ and $.023$, respectively). Pain medications were administered less frequently in dogs receiving PEMF treatment during the 7 day postoperative period compared with the control treatment group ($P = .010$) with codeine administered 1.8 times more frequently in the control group. No untoward effects were recorded in either treatment group. More frequent evaluation of outcome measures with larger patient numbers, as well as histologic samples, may be useful in future studies. Dogs receiving PEMF therapy following postoperative hemilaminectomy demonstrated improved wound scores at 6 wk and reduced mean number of owner-administered pain medications compared with the control group therapy. (*J Am Anim Hosp Assoc* 2019; 55:83–91. DOI 10.5326/JAAHA-MS-6798)

Introduction

Intervertebral disc disease (IVDD) is the most common spinal cord injury of dogs and leads to pain, paralysis, and substantial morbidity.¹ Dogs with severe neurologic deficits (nonambulatory or ambulatory) who do not respond to medical management often require surgical intervention and significant postoperative care. Chondrodysplastic breeds between the ages of 2 and 8 yr old are most commonly affected with disc herniation attributed to degeneration and subsequent extrusion of the nucleus pulposus, termed Hansen Type 1 disc

extrusion.² The severity of spinal cord dysfunction following extrusion has been primarily attributed to the velocity and duration of spinal cord compression and subsequent swelling and inflammation of the cord.³ Owner-perceived quality of life assessment scores following spinal cord injury in dogs are higher for ambulatory than nonambulatory dogs, regardless of underlying etiology.⁴

Functional recovery following intervertebral disc (IVD) extrusion and hemilaminectomy varies from days to several weeks, and in some cases, IVDD leads to permanent paralysis.^{1,2} Return to

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CSU (Colorado State University); IVD (intervertebral disc); IVDD (intervertebral disc disease); PEMF (pulsed electromagnetic field); PO (*per os*); VAS (visual analogue score); WES (wound evaluation scale)

The online version of this article (available at www.jaaha.org) contains supplementary data in the form of two figures.

Accepted for publication: May 21, 2018.

motor activity and time to ambulation is dependent on a number of factors including the length of time to presentation, the presence or absence of deep pain perception at the time of presentation, and successful surgical intervention.^{5–7} Current recovery rates to ambulation for dogs with intact deep pain perception are good to excellent; however, for dogs lacking deep pain perception, recovery rates vary from 38 to 76%.⁵ Effective postoperative care aimed at reducing pain, swelling, and inflammation is important to promote rehabilitation and foster earlier return to ambulation.^{8,9}

Pulsed electromagnetic field (PEMF) therapy offers potential to promote wound healing and reduce pain and inflammation, as evidenced by multiple human clinical trials.^{10–14} Information regarding its use in veterinary medicine, however, is sparse. One prospective study that evaluated PEMF to promote wound healing in the skin of the trunk of 12 dogs found that PEMF treatment significantly enhanced wound epithelialization compared with the control 10 and 15 days after surgery.¹⁵ Others have described an FDA-approved, portable, battery-operated device to promote wound repair, increase angiogenesis, reduce lymphedema, and improve postoperative pain control.^{12–18} PEMF has also been demonstrated to stimulate regeneration of peripheral nerves after experimentally induced injury and improve return of motor function in rats and cats, as well as reduce pain in naturally occurring diabetic peripheral neuropathy in humans.^{19–23} In a small study with experimentally induced acute spinal cord injury in cats, motor recovery was significantly improved in PEMF-treated cats compared with control cats.²¹ These benefits were noted as early as 1 wk postinjury and continued through the end of the 12 wk study. In another study evaluating experimentally induced sciatic nerve crush injury, short-term exposure of rats to whole-body PEMF application (4 hr/day for 5 days) resulted in enhanced return of function as compared with the control group.²² Collectively, these findings support that PEMF may have value in management of tissue injury and postoperative recovery. Targeted PEMF may represent a promising modality for dogs undergoing hemilaminectomy surgery to manage IVDD. At the time of writing, PEMF had not been studied in naturally occurring canine IVDD.

The purpose of the current study was to evaluate postoperative pain, wound healing, and functional outcome of dogs following hemilaminectomy by comparing affected dogs treated with PEMF with those in a control group. We hypothesized that dogs receiving targeted PEMF therapy following hemilaminectomy would have reduced pain scores and improved incisional wound healing and experience faster time to ambulation as compared with the control.

Materials and Methods

Study Devices

A portable, battery-operated device that delivers targeted PEMF at 27.12 MHz with 2 msec pulse duration at 2 Hz and peak induced

magnetic field of 4 μ T was used^a. This device is activated by a manual power button that triggers a green blinking signal while it delivers pulsed continuous PEMF therapy for 15 min. It then automatically shuts off. Control devices were produced as an exact replica of the therapeutic device but delivered no electromagnetic therapy. All clinicians, nurses, and clients involved in the study were blinded to knowledge as to whether the study device was the therapeutic or control product. Sixty study devices were manufactured specifically for the present study. Each device was labeled with a serial number from 01 to 60 to result in 30 active devices and 30 control devices assigned through sequential patient randomization.

Animals

The study protocol was reviewed and approved by the Institutional Animal Care and Use Committee of The Animal Medical Center, NY. Written informed owner consent was required for participation. There were no gender or breed exclusion criteria for enrollment; however, age was restricted between 2 and 10 yr old and weight between 4 and 30 kg. Dogs surgically managed with hemilaminectomy for T3–L3 myelopathy because of disc extrusion IVDD were prospectively recruited between November 2014 and October 2015. All dogs had nonambulatory paraparesis or paraplegia at the time of surgery with neurologic grade 3 or greater. Exclusion criteria included dogs who had prior episodes of paresis from IVDD, masses or other spinal lesions unrelated to IVDD, seizures, arrhythmias, or concurrent conditions that could affect postoperative recovery (osteoarthritis, diabetes mellitus, renal failure, neoplasia, severe pyoderma, etc.), and patients receiving medications not related to treatment of IVDD.

Procedures

All patients were evaluated preoperatively by either a board-certified neurologist or a neurology resident under the supervision of a board-certified neurologist who performed the surgery and postoperative evaluations. Each case was prospectively randomized to receive postoperative PEMF or control device therapy. Randomization was determined using a commercially available random sequence generator^b. MRIs were performed in all dogs. The number of intervertebral spaces that were operated were based upon MRI findings that revealed the site, degree, length, and laterality of acute disc extrusion and spinal cord compression. Intervertebral disc extrusion was confirmed at surgery and further treated by dorsolateral annulotomy via sharp dissection with a #11 blade to facilitate manual evacuation of remaining nucleus pulposus using a curette. All patients were hospitalized and received standard postoperative nursing care until time of discharge. This included cold-packing over the incision *q* 6 hr for the first 24 hr, turning sides *q* 6 hr

until independent pelvic limb movement was noted, and manual bladder expression *q* 6 hr until voluntary urination was noted. Patients also received IV opioids (methadone hydrochloride 0.2 mg/kg or oxymorphone hydrochloride 0.1 mg/kg) *q* 6 hr for the first 48 hr. Patients were transitioned to receive codeine (1–2 mg/kg *per os* [PO] *q* 6 hr) until discharge.

Study treatment (PEMF or control) sessions were administered *q* 6 hr for 15 min during hospitalization, followed by *q* 12 hr home therapy for 7 days following surgery. The device was placed centered over the dorsal incisional line to provide treatment to the entire surgical area and was secured with a soft bandage or monitored closely in order to ensure the device remained correctly positioned over the treatment area (**Figures 1A, B**). Owners were also instructed in person and in writing during the discharge process on



FIGURE 1 Demonstration of hospitalized patients receiving targeted PEMF therapy following hemilaminectomy. The device was placed centered over the dorsal incisional line and was (A) secured with a soft bandage or (B) manually held to ensure correct placement of the device. PEMF, pulsed electromagnetic field.

how to correctly administer this treatment. Owners stayed with their pets during the 15 min sessions and recorded the exact time of the treatment in the owner questionnaire. Pain medications (codeine 1–2 mg/kg PO when necessary up to *q* 6 hr and/or gabapentin 10–20 mg/kg PO when necessary up to *q* 8 hr) were administered at the discretion of the owner based on owner-assessed level of pain. Adverse events were assessed as any hypersensitivity reaction (increase in redness, swelling, or pruritus) over the treatment area immediately following PEMF treatment. Any other immediate reactions during PEMF treatment including vomiting, diarrhea, severe discomfort, or restlessness were recorded.

Outcome Measures

Patients were evaluated immediately postsurgery (day 0) and *q* 12 hr during hospitalization for pain- and neurologic-grade assessment as outlined below. Identical outcome measures were evaluated during recheck examinations at day 14 ± 3 and day 42 ± 3 . Wound healing was evaluated by a board-certified surgeon at day 0, 14 ± 3 , and 42 ± 3 . Following hospital discharge, clients filled out medical questionnaires twice daily up until 7 days postoperative (**Supplementary Figure I**). Recorded data included time log of PEMF treatments, frequency of oral pain medication, pain score, and number of days to establishment of return to function (ability to stand, wag tail, voluntary urination, and voluntary ambulation).

Pain Scale

The Colorado State University (CSU) Veterinary Medical Center Canine Acute Pain Scale was used to evaluate patients *q* 12 hr until hospital discharge and at home by owners on the client questionnaire twice daily until 7 days postoperative.²⁴ Pain scores were assigned from 0 to 4 with higher scores indicating a higher level of pain. All pain scores were recorded prior to application of the study device.

Neurologic Grading

During hospitalization, patients were evaluated twice daily (during morning and evening exams, approximately *q* 12 hr) for level of neurologic function by the same board-certified or resident neurologist who was blinded to the treatment groups. Neurologic grading was assigned as outlined in previous studies, in which neurologic grade 0 = normal, 1 = thoracolumbar spinal pain without neurologic deficits, 2 = ambulatory paraparesis (mild, moderate, severe), 3 = nonambulatory paraparesis, 4 = paraplegia with intact nociception, and 5 = paraplegia with absent deep nociception.^{5,25}

Wound Healing

The incisional wound of all patients was photographed immediately postoperatively (day 0) with high-resolution images (1334×750

pixel resolution or 326 pixels/in.). A metric tape was placed next to the incision as a reference to aid in wound evaluation scores and to ensure images were the same size and perspective. Incisional wounds were evaluated by the same board-certified surgeon who was blinded to the treatment groups. The following two measures were used to evaluate wound healing: (1) visual analogue score (VAS) on a 100 mm incision scale (0 = worst possible incision and 100 = best possible incision) and (2) wound evaluation scale (WES), in which points are assigned according to step-off borders, contour irregularity, scar width, edge inversion, inflammation, and overall cosmesis (**Supplementary Figure II**).²⁶ Higher scores for VAS and WES indicate superior wound healing.

Statistical Analysis

The median and interquartile range (25th–75th percentile) were reported for continuous variables and frequencies (percentage) for discrete variables. The Wilcoxon rank-sum test was used to compare all continuous veterinarian-assessed and client-reported outcome variables between PEMF and control treatment groups, as well as number of IVD sites that were cut and median days of hospitalization between the groups. A post hoc power calculation was done to determine the number of patients needed to find a significant difference in CSU pain scores and time to ambulation between treatment groups. The Fisher exact test was used to determine if there was an association between the number of fenestrations and the side that was cut (left or right). A linear regression analysis was used to model neurologic grade at day 14 and week 6 by treatment group, controlling for neurologic grade at the baseline (day 0) as a means to determine the effect of the treatment group between two time points. A two-sample *t* test was used to assess change in neurologic score from day 0 to recheck at day 14 and week 6 between groups (difference in score from day 0 to day 14 and week 6). For client-reported outcomes (i.e., regaining ability to stand, urinate, walk, pain score), the difference in time to event was estimated by the Kaplan-Meier method, and the treatment groups were compared with the log-rank test. Patients who never regained the ability (to stand, wag tail, voluntarily urinate or walk) during the 6 wk study period were censored at the last date of the 7 day period that the client recorded. Censoring was truncated at 7 days postoperative as per the study protocol. Client-reported pain scores that were a 0 or 1 on the CSU pain scale, were considered nonpainful. In addition, among a subset of patients who ever regained each activity, the number of days to regain the functional ability was compared between treatment groups. A two-sample *t* test was used to compare the mean number of times owners administered pain medication at home. The data was analyzed using commercially available statistical computing software^c. All *P* values were two sided with statistical significance evaluated at the .05 alpha level.

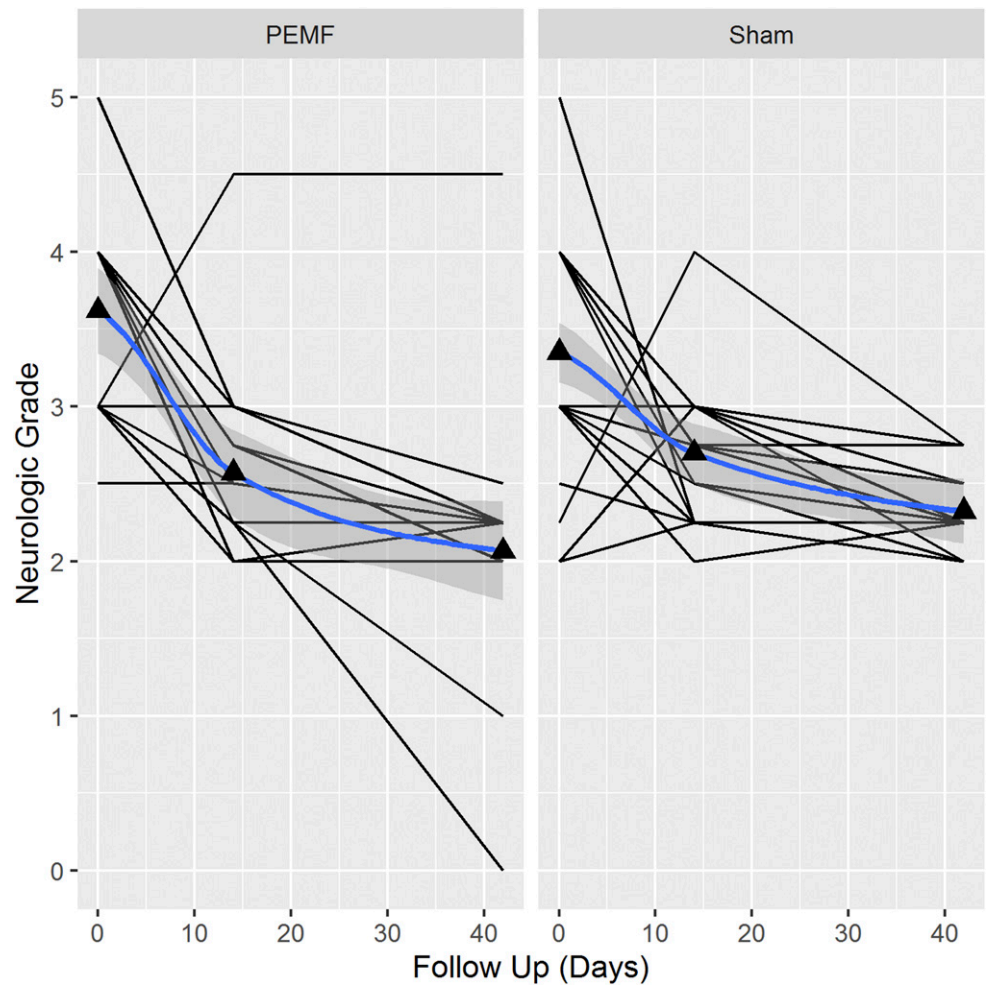
Results

Sixty dogs met entry criteria. Seven were disqualified because of study protocol violations including missed immediate postoperative period treatment (*n* = 3), damage to the treatment device from patient chewing (*n* = 2), medical complication of myelomalacia (*n* = 1), and failure to obtain incisional photographs on day 0 (*n* = 1). The final study population included 53 dogs; 27 were in the PEMF (test) group and 28 were in the control group. A comparison of patient baseline demographics is detailed in **Table 1**. The treatment groups did not differ significantly with regard to age, gender, body weight, number of IVD sites, fenestrations, or laterality (**Table 1**). Veterinarian-assessed pain and neurologic scores did not differ significantly between the treatment and control group for any of the postoperative evaluation days (**Table 2**). A post hoc power calculation revealed that a total of 152 patients (72 per group) would be needed to provide 85% power to detect a significant difference in CSU pain scores and a total of 82 patients (41 per group) to detect a significant difference in time to ambulation. The median neurologic grade on day 0 was 4 in the PEMF group, compared with 3 in the control group, and improved to 2.5 and 2.25 in the PEMF group at day 14 and week 6, respectively, compared with 2.75 and 2.25 in the control group, respectively (**Table 2**). Median neurologic grades improved over time in both treatment groups and did not yield statistically significant differences between PEMF and control groups (**Figure 2**).

Linear regression analysis demonstrated that a higher neurologic grade at the baseline (day 0) was significantly associated with a higher neurologic grade at week 6 ($\beta = 0.90$, $P < .0001$). The difference in mean neurologic grade over time was 1.06 ± 1.06 at week 6 in the PEMF group compared with 1.04 ± 0.72 in the control group ($P = .051$). At day 14, the PEMF group had a mean improvement of 1.05 ± 0.78 , compared with the control group at 0.65 ± 0.65 ($P = .083$).

Dogs receiving PEMF therapy had a significantly greater median VAS and WES incisional score at 6 wk ($P = .010$ and $.023$, respectively) compared with the control group (**Table 2**). According to owner-reported outcomes, there were no observed differences between treatment groups in the median time to achieve each functional task (**Table 3**). Among the subset of patients (*n* = 16) that regained ability to walk during the 7 day postoperative period, the control group had a longer recorded median time to walk compared with the PEMF group (6 versus 3 days, respectively), but this was not statistically significant ($P = .08$; **Table 3**). Out of the 43 patients who presented for the day 42 evaluation, only 1 dog did not regain the ability to walk. This patient was in the PEMF group. There were no statistical differences between the groups for other functional abilities in the time it took to stand, wag tail, or voluntarily urinate or in median CSU pain scores (**Table 3**). In addition, there was no

FIGURE 2 Spaghetti plots of veterinarian-reported neurologic grade at baseline (day 0), 14 days, and 42 days (6 wk) following hemilaminectomy with PEMF therapy versus placebo. The locally weighted scatterplot smoothing is fit to the data and plotted in blue with standard errors in grey shading. Differences in median neurologic grade were not statistically significant between treatment groups at day 0 ($P = .160$), 14 days ($P = .141$), or 6 wk ($P = .157$). PEMF, pulsed electromagnetic field.



significant difference in median days of hospitalization between groups ($P = .799$). Patients in the control group had a significantly higher number of occurrences in owner-administered pain medication compared with the PEMF group during the 7 day postoperative recording period ($P = .010$; Table 3). Oral codeine was administered at home a total of 288 times in the study population and was administered 1.8 times more frequently in the control group (187 occurrences, 65% frequency) compared with the PEMF group (101 occurrences, 35% frequency). There were no reported adverse events attributable to study device sessions in the study population for either group.

Discussion

This study is the first prospective, randomized clinical trial to evaluate the effects of PEMF compared with placebo on dogs recovering from hemilaminectomy. In our study population, we found PEMF improved wound scores at week 6 and resulted in less pain medication administration at home. We rejected the hypothesis that PEMF yields a faster time to ambulation or improved pain scores at any of the selected time points.

It is well known that presenting neurologic status affects the clinical outcome for dogs with IVDD.^{3,5-7} Therefore, we would expect that patients presenting with more severe clinical symptoms would have a worse outcome. In order to control for this, we attempted to standardize the study by including only non-ambulatory dogs with neurologic grade 3 or greater. On closer examination, however, the PEMF treatment group had a higher median neurologic score immediately postoperative (day 0) than the control group (median neurologic score 4 versus 3, respectively; Table 2). One might argue that the PEMF group had a higher chance of improving postoperatively because the starting score was worse; however, there was no statistical difference between the groups at any individual time points (Figure 2). When evaluating changes in neurologic grade over time from day 0 to day 14 and week 6, we noted more improvement in mean neurologic grade in the treatment group compared with the control group at week 6; however, this was not statistically significant ($P = .051$).

Significant difference was recorded when owners had the option to administer pain medications at home. The PEMF treatment group

TABLE 1**Demographics of Study Patients**

Variables	All (n = 53)*	PEMF (n = 27)*	Control (n = 28)*	P
Age, yr	5.20 [4.00; 7.00] (1.70–10.5)	5.50 [5.00; 7.00] (1.70–10.33)	4.62 [3.50; 7.10] (2.00–10.50)	.225
Gender				.370
F (%)	21 (39.6)	12 (48.0)	9 (32.1)	
M (%)	32 (60.4)	13 (52.0)	19 (67.9)	
Weight, kg	7.70 [5.68; 11.3] (3.22–33.6)	7.70 [5.60; 10.4] (3.31–30.30)	7.75 [5.99; 11.5] (3.22–33.60)	.742
IVD sites	2 [1; 2] (1–4)	2 [1; 2] (1–4)	2 [1; 2] (1–4)	.383
Fenestration				.610
0 (%)	50 (94.3)	25 (93)	27 (96.4)	
≥1 (%)	3 (5.7)	2 (7.0)	1 (3.6)	
Laterality				.254
Left (%)	18 (34)	18 (34)	7 (25)	
Right (%)	35 (66)	16 (59)	21 (75)	

Number of IVD sites, fenestrations, and laterality of surgery for dogs receiving PEMF therapy following hemilaminectomy.

*Data is presented as median and interquartile range [25%; 75%] and full range (min, max) for continuous variables; the number and percentage (%) is listed for discrete variables.

F, female; IVD, intervertebral disc; M, male; PEMF, pulsed electromagnetic field.

had significantly fewer occurrences of total medication administration as compared with the control group. Higher frequency of codeine administration, in particular, was noted in the control group. This finding has also been substantiated in the human PEMF literature.^{11,12} This is an important finding given the current epidemic in human opioid abuse and provides an opportunity to treat pain nonpharmacologically to help reduce use of controlled pharmacologic pain medications.

Improved wound healing, as assessed by both VAS and WES, was only statistically significantly improved at 6 wk following surgery and not at day 14 as one would expect. This may have been caused by the lack of assessment at earlier time points when most wound healing is expected to occur, lack of more frequent PEMF treatments, or lack of effectiveness during this particular phase of wound healing. More frequent time evaluation points would have helped to determine whether improvements occurred at earlier postoperative intervals, given that wound healing was only assessed at days 0, 14, and 42. Most wound healing complications tend to occur during the first several days following surgery, and such changes may have been missed. The specified study evaluation time points were selected in order to standardize postoperative assessments. Because hospitalization time varied from patient to patient, and in order to evaluate the wounds at comparable time intervals, we chose to assess at day 0 and during the day 14 recheck hospital visit. This decision was also substantiated by previous studies in which the benefits of PEMF therapy on wound healing in dogs were noted 10 and 15 days postinjury.¹⁵ We did not consider owner evaluations at home as a

valid possibility for assessment. This would have required substantial training of individuals without a medical background and would have added substantial variability regarding the integrity of these assessments. Instead, we chose to rely on observations made by one experienced board-certified surgeon, who made all the evaluations.

There were several limitations in the present study. A larger number of affected dogs would have improved statistical power to substantiate trends in pain scores and time to ambulation. As demonstrated in the post hoc power calculation, a sample size of at least 30 more patients would be necessary to demonstrate more significant patterns. Another limitation was that all patients received pain medication while hospitalized regardless of pain assessment, which precluded our ability to evaluate whether PEMF could impact dose and frequency of in-hospital pain management. This decision was made because of varying nursing staff who would be responsible for assigning pain scores and clinician preference to maintain consistent pain medication. Additionally, earlier and more frequent assessments may have allowed us to detect a return of ambulation and other functional activities that may have been missed because patients were only rechecked at day 14 and week 6 and owners only recorded changes from time of discharge until 7 days postoperative. This decision was made in order to improve owner compliance and also to adhere to the standard protocol used at our hospital for postoperative hemilaminectomies. More frequent time evaluation points would have helped to determine whether improvements occurred at earlier postoperative intervals. Finally, histologic samples would have improved our ability to objectively evaluate wound healing rather than the subjective VAS and WES used in our current study design.

TABLE 2

Veterinarian-Reported Outcome Measures by Treatment Group on Neurologic Grade, CSU Pain Score, Incisional VAS, and WES Following Hemilaminectomy with PEMF Therapy Versus the Control Group^{24,26}

Variable	All* n = 53	PEMF* n = 27	Control* n = 28	P	N
Neurologic grade					
Preop	3.00 [3.00; 4.00] (3, 5)	4.00 [3.00; 4.00] (3, 5)	3.00 [3.00; 4.00] (3, 5)	.096	53
Day 0	4.00 [3.00; 4.00] (2, 5)	4.00 [3.00; 4.00] (2.5, 5)	3.00 [3.00; 4.00] (2, 5)	.160	53
Day 14	2.50 [2.25; 3.00] (2, 4.5)	2.50 [2.25; 2.75] (2, 4.5)	2.75 [2.25; 3.00] (2, 4)	.141	53
6 wk	2.25 [2.25; 2.38] (0, 4.5)	2.25 [2.12; 2.25] (0, 4.5)	2.25 [2.25; 2.50] (2, 2.75)	.157	43
CSU pain score					
Day 0	1.00 [0.00; 2.00] (0, 3)	1.00 [0.00; 2.25] (0, 3)	1.00 [0.00; 2.00] (0, 3)	.977	52
Day 1	1.00 [0.00; 1.00] (0, 2)	0.00 [0.00; 1.00] (0, 2)	1.00 [0.38; 1.00] (0, 2)	.109	53
Day 14	0.00 [0.00; 0.00] (0, 1)	0.00 [0.00; 0.00] (0, 1)	0.00 [0.00; 0.00] (0, 1)	.360	53
VAS incision					
Day 0	50.0 [30.0; 60.0] (0, 90)	50.0 [30.0; 60.0] (0, 80)	50.0 [30.0; 70.0] (10, 90)	.633	51
Day 14	70.0 [50.0; 80.0] (20, 90)	70.0 [60.0; 80.0] (40, 90)	60.0 [50.0; 75.0] (10, 90)	.350	41
6 wk	70.0 [70.0; 80.0] (40, 100)	80.0 [70.0; 87.5] (70, 100)	70.0 [60.0; 75.0] (20, 90)	.010	37
WES					
Day 0	3.00 [1.50; 4.00] (0, 6)	3.00 [1.50; 4.00] (0, 5)	3.00 [1.75; 4.25] (1, 6)	.537	51
Day 14	5.00 [3.00; 5.00] (1, 6)	5.00 [4.00; 5.00] (3, 6)	4.00 [3.00; 5.00] (1, 6)	.422	40
6 wk	5.00 [4.00; 6.00] (1, 6)	5.50 [4.25; 6.00] (4, 6)	4.00 [4.00; 5.00] (1, 6)	.023	37

*Data is presented as median and interquartile range [25%; 75%] and full range (min, max).

CSU, Colorado State University; PEMF, pulsed electromagnetic field; VAS, visual analog score; WES, wound evaluation scale.

As the field of animal rehabilitation continues to develop, there is a need to substantiate modalities intended to improve healing. Veterinary rehabilitation practitioners commonly use physical modalities to help improve outcome in their patients, yet few of these modalities have been prospectively studied. Approximately 7708 dogs per year are affected by IVDD (2.3% prevalence); therefore, any

modality that improves outcome for these patients could have substantial positive impact in the recovery of many dogs.^{1,27} One study reported faster time to ambulation in dogs receiving laser therapy following hemilaminectomy.⁸ However, the investigators in this study were not blinded, the groups were not randomized, and the control group did not receive a placebo treatment. In another

TABLE 3

Owner-Reported Outcome Measures by Treatment Group for Number of Days to Regain Functional Abilities, CSU Pain Score, and Number of Pain Medications Administered at Home During the 7 Day Postoperative Period Following Hemilaminectomy with PEMF Therapy Versus the Control Group²⁴

Variables	ALL	PEMF	Control	P	N
Functional ability*					
Postop days to stand	4.00 [3.00; 6.00]	4.00 [3.00; 4.50] n = 8	5.00 [3.50; 6.00] n = 15	.447	23
Postop days to wag tail	3.00 [3.00; 4.50]	3.00 [3.00; 4.00] n = 13	3.00 [3.00; 4.75] n = 22	.511	35
Postop days to urinate	3.00 [2.75; 4.00]	3.00 [2.00; 3.00] n = 12	3.00 [3.00; 4.00] n = 20	.181	32
Postop days to walk	4.00 [3.00; 6.25]	3.00 [3.00; 4.50] n = 7	6.00 [4.00; 7.00] n = 9	.080	16
CSU Pain Score*	2.0 [1; 2]	1.0 [0; 1.5] n = 15	1.0 [0.875; 1.25] n = 22	.764	37
Number of pain medications [†]	8.43 ± 5.13	6.06 ± 4.67, n = 17	10.17 ± 4.83, n = 23	.010	40

*Data is presented as median and interquartile range [25%; 75%].

[†]Data is presented as mean ± standard deviation.

CSU, Colorado State University; PEMF, pulsed electromagnetic field.

study, photobiomodulation (also known as low-level laser therapy) and physical rehabilitation with placebo photobiomodulation did not improve early outcome variables for dogs recovering from hemilaminectomy, although the treatment groups were small ($n = \leq 11$).⁹

The PEMF device used in the current study is FDA cleared for adjunctive treatment of postoperative pain and edema in soft tissues and was not associated with any deleterious effects. In addition, the use of the device was easy for both owners and practitioners to deliver PEMF therapy both in-hospital and at home and warrants consideration for postoperative treatment of dogs recovering from hemilaminectomy. In addition, we have new knowledge of a prospective clinical trial that was initiated after the present study that evaluated 16 dogs surgically treated for severe thoracolumbar IVDD. The investigators used the same PEMF device used in the present study. Results from this study reported significantly improved proprioceptive placing at 6 wk, reduced plasma biomarker associated with neurological injury at 2 wk, and reduced incision-associated pain (measured by mechanical sensory thresholds) in PEMF-treated dogs compared with the control. This data helps support the findings of the present study.²⁸

Conclusion

PEMF therapy appears to be a safe treatment modality that may improve postoperative outcomes in dogs undergoing hemilaminectomy for Type I IVDD. Statistically significant improvements in wound scores at 6 wk and a reduced number of owner-administered pain medications compared with the placebo therapy were noted. Future prospective studies with larger sample sizes may help to further substantiate the benefits of PEMF therapy for postoperative spinal cord injury in dogs. ■

FOOTNOTES

^a Assisi Loop; Assisi Animal Health, Northvale, New Jersey

^b ADM Tronics Unlimited, Northvale, New Jersey

^c R version 3.3.1; R Foundation for Statistical Computing, Vienna, Austria

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