THE USE OF PIEZOELECTRIC SHOCKWAVE IN MEDICALLY MANAGED CRANIAL CRUCIATE LIGAMENT RUPTURE

Heather Owen, DVM, MAV, CCRP, MT, CCFT
Owner of Animal Acupuncture LLC
Tulsa, OK

Introduction

Thirty client owned patients, ranging in age from two to fifteen years old, were randomly divided into two groups to evaluate the efficacy of piezoelectric shockwave therapy in the treatment of medically managed cranial cruciate ligament ruptures.

Inclusion criteria was: Grade 2/5 – 5/5 lame, demonstration of a cranial drawer response, radiographic evidence of cranial displacement of the fat pad and absence of audible meniscal click.

Each patient received four treatments after the initial evaluation and data collection. After the initial evaluation and initiation of treatment, patients were restricted to cage rest with controlled exercise. Four weeks post last treatment, patients were re-evaluated using the same measurement parameters.

Discussion

Cranial cruciate disease is a very common cause of hindlimb lameness in the canine species (4). Often, these patients are not surgical candidates. Medical and modality-based treatment is sought to achieve a better quality of life.

Extracorporeal shockwave treatment is a non-invasive therapy that uses mechanical transduction to stimulate biological healing in different cell types through different molecular cascades. Extracorporeal shockwaves are produced outside the body and are acoustic waves of high pressure and velocity that are produced by converting electrical energy to mechanical energy.

In biologic tissue the pressure waves release energy when tissue density changes are encountered (1). The waves produced are characterized by high-amplitude acoustic pressures (50 MPa) with a short build-up time (5-10 nanoseconds) exponential decay to baseline to a negative deflection (10MPa) and a wave cycle time of 300 nanoseconds.

Piezoelectric generators use crystals that expand and deform when stimulated by high voltage electricity, initiating a pressure wave. The energy is delivered to the patient using a coupling gel in addition to a handheld applicator. Tissue depth penetration can reach up to 3cm. (5) This study used a piezoelectric shock wave device made by Richard Wolf; the Piezowave2.

At the cellular level, mechanosenitive stem cells, osteoblasts, chondrocytes and tenocytes absorb this energy and are biostimulated. Biologic changes in the signaling pathways include upregulation of TGF-alfa-1 expression and NO production, as well as suppression of NF-kappa-B activity and pro-inflammatory cytokines production.

Data & Evaluation

Objective data collected included:

1. Stance analyzer values
2. Goniometric measurements of stifle extension
3. Measurements of the thigh circumference

Subjective evaluations included:

1. Gait analysis for lameness score determination used the Hudl gait evaluation app on an I Phone with videos captured at the height of the dog's limbs. The dog was videoed gaiting to and from the practitioner and also laterally from both the left and right sides.
2. Physical examination evaluations noting stifle effusion presence or absence, cranial drawer and thrust responses, and the presence of medial buttress or crepitus.
3. Owner questionnaire assessing; the ability to stand, sit, walk, posture to urinate and defecate, appetite, water intake and lameness. The Colorado State Pain Assessment Scale and Glasgow Pain Score records were also maintained. (2)(3)

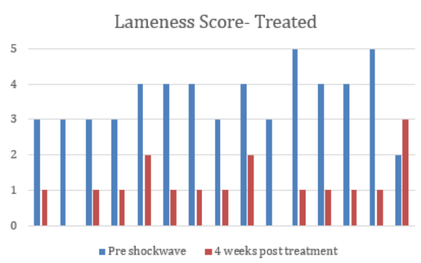
Procedure

Patients were randomly selected and divided into either the placebo or shockwave therapy groups. All animals (whether placebo or real) were placed in lateral recumbency with stifle slightly flexed. An acoustic standoff pad was placed between the hand piece and patient's stifle being certain that ultrasound gel was present on the patient skin and between the standoff pad and hand piece.

The machine was set to 0.1mJ/mm2 with 750 shocks delivered per treatment at a rate of 8 Hz with the probe positioned over medial stifle joint space. For the patients over 25lbs a 10 mm standoff pad was utilized, for patients under 25lbs, a 5 mm standoff pad was utilized. In total, four total treatments were performed.

The only difference between the placebo group and those patients receiving therapy was that in the placebo group the standoff pad was held 2 inches from the patient so neither the practitioner nor owner could identify who was receiving contact treatment and who was not.

Another complete evaluation and collection of data was performed after completion of the four therapy sessions and again 4 weeks after the last shockwave session.



Difference in Measurements Between Initial Evaluation and Four weeks Post Final Treatment

Treatment Group

Patient number	Change in lameness (out of 5)	Change in stifle extension (%)	Change in affected leg stance (%)	Change in thigh circumference (cm)
1	-2	15	7	3
2	-3	10	5	3
6	-2	38	4	2
9	-2	30	17	3
10	-2	20	18	2
14	-3	40	6	3
15	-3	16	13	1
18	-2	25	2	3
19	-2	32	3	2
20	-3	20	6	2
21	-4	23	3	4
25	-4	11	5	2
28	-3	8	11	2
30	-4	20	7	3
5*	1	10	0	-1

Placebo

Patient number	Change in lameness (out of 5)	Change in stifle extension (%)	Change in affected leg stance (%)	Change in thigh circumference (cm)
3	-2	**45**	0	3
4	-2	27	2	1
7	-2	15	8	1
11	-1	5	2	1
12	0	5	1	1
13	-1	5	1	0.5
17	-1	19	0	-3
22	0	10	-2	0
23	-1	5	5	0
24	0	0	5	0
26	-2	3	16	2
27	0	-6	1	3
29	1	0	6	0

Results

Treatment group:

- 14/15 demonstrated gait improvement: 93%
- Lameness was resolved in 12/15: 80%·
- Thigh circumference increased in all patients.
- Improvement in the stance analysis data in all but one patient: 93%
- There was a 10° or more increase in stifle extension in all but one patient: 93 %

Placebo group

- 3/13 patients showed zero improvement when evaluated for stifle effusion, crepitus, and cranial drawer and tibial thrust responses.
- 4/13 demonstrated a > one point improvement in lameness: 31%
- Only one lameness was resolved: 7.69%
- Minimum improvement in thigh circumference
- One patient had a large change in stance analysis
- 4/13 had a > 10% increase in stifle extension: 31%

Conclusion

- 93.3% of the treatment group demonstrated improvement
- 80% of the treatment group had a total resolution of lameness.
- 100% of the placebo group did not demonstrate significant improvement in joint effusion or measurements of the thigh circumference.
- Only 15.4% of the placebo group showed improvement in lameness scores.

Patients in the treatment group were evaluated monthly for 12 months post shockwave treatment. All dogs that responded continued to improve, running, and jumping again. Two of the patients in the treatment group were evaluated quarterly five years post shockwave treatment and are still sound.

Pictured above: A dog receives extracorporeal shockwave treatment with the Richard Wolf PiezoWave2 device.