Extracorporeal Shockwave Therapy for Shoulder Lameness in Dogs

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ABSTRACT

The purpose of this article was to describe the outcome of dogs with instability, calcifying, and inflammatory conditions of the shoulder treated with extracorporeal shockwave therapy (ESWT). Medical records for 15 dogs with lameness attributable to the shoulder that failed previous conservative management were retrospectively reviewed. ESWT was delivered to those dogs *q* 3–4 wk for a total of three treatments. Short-term, in-hospital subjective lameness evaluation revealed resolution of lameness in three of nine dogs and improved lameness in six of nine dogs available for evaluation 3–4 wk following the final treatment. Long-term lameness score via telephone interview was either improved or normal in 7 of 11 dogs (64%). ESWT may result in improved function based on subjective patient evaluation and did not have any negative side effects in dogs with lameness attributable to instability, calcifying, and inflammatory conditions of the shoulder. (*J Am Anim Hosp Assoc* 2015; 51:000–000. DOI 10.5326/JAAHA-MS-6175)

Introduction

Extracorporeal shockwave therapy (ESWT) employs focused, single-pressure pulses of acoustic waves, microseconds in duration, to stimulate healing.[1] The exact mechanisms of therapeutic action are unknown but are thought to include direct stimulation of healing by neovascularization, disintegration of mineralization, and/or analgesic effects.[1,2] Despite an incomplete understanding of its effects, ESWT has been shown to aid in treatment of human musculoskeletal problems when conservative management has failed.[3]

Use of ESWT has only rarely been described in small animal veterinary practice but has been shown to decrease the severity of patellar desmitis, improve peak vertical force in 60% of dogs with osteoarthritis of the stifle, and improve ground reaction forces in dogs with coxofemoral osteoarthritis.[4–6] Several case reports also describe its successful use in treating calcifying tendinopathies in dogs. Two dogs with supraspinatus tendinopathy were found to have improved peak vertical impulse after treatment, and another dog with bicipital tendinopathy was subjectively improved 4 wk after treatment.[7,8] Given the scant information in the small animal literature, the study authors report both short- and long-term outcomes using ESWT to treat lameness and pain in a larger series of dogs affected by instability, calcifying, and inflammatory conditions of the shoulder.

Materials and Methods

Hospital records from XXXX were searched for dogs that received ESWT for shoulder lameness between August 2005 and August 2010. Inclusion criteria were failure of conservative management, treatment with an electrohydraulic extracorporeal shockwave unit[a], and lameness attributable to instability, calcifying, and inflammatory injuries of the shoulder. Failure of conservative management was defined as either no resolution of lameness or progression of

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ESWT *extracorporeal shockwave therapy*; NSAID *nonsteroidal anti-inflammatory drug*

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lameness despite some combination of exercise restriction and analgesics, including nonsteroidal anti-inflammatory drugs (NSAIDs), slow-acting disease modifying osteoarthritis drugs (i.e., glucosamine/chondroitin formulations), and/or tramadol[b]. All dogs had pain on palpation of the affected shoulder. The diagnosis of either an inflammatory or calcifying tendinopathy was based on radiographic and/or ultrasonographic abnormalities, including mineralization, loss of regular fiber pattern, and/or hypoechogenicity within the tendon. Diagnosis of medial shoulder instability was made based on shoulder abduction angle greater than 45° and/or arthroscopic evidence of tearing in the medial glenohumeral ligament and/or subscapularis tendon. Dogs with clinical, radiographic, and/or arthroscopic evidence of elbow osteoarthritis were excluded.

Data collected from the records included signalment, diagnosis, duration of lameness, modalities used for diagnosis, and lameness assessment at each recheck. The number of impulses and energy of impulses delivered were recorded and are reported as results.

Lameness was evaluated during the dog's last examination by a board-certified surgeon observing the dog at a controlled walk. Lameness was subjectively scored as worse, same, better, or normal compared to pretreatment levels.

Informed client consent was obtained for treatment, and ESWT was administered via an ESWT unit *q* 3–4 wk for a total of three treatments. Dogs were administered dexmedetomidine (6 µg/kg) and butorphanol (0.2 mg/kg) IV for each treatment, and a small area over the affected shoulder was shaved. Coupling gel was applied to the treatment area, and ESWT was applied over the scapulohumeral joint with emphasis on the affected anatomic structure(s). ESWT electrode settings were based on recommendations from the manufacturer. The activity of the dogs was limited to short walks on a hand-held leash after the first treatment until evaluation 3–4 wk after the final treatment (i.e., 12–16 wk total). At the discretion of the attending clinician, the dogs may have received either an NSAID or tramadol during the treatment period.

Description of lameness at the final evaluation by a veterinarian was obtained from the medical record, and long-term outcome was determined via telephone interview of the client. Clients were asked to score functional outcome and durability of treatment using questions from a previously validated questionnaire modified to assess pain and lameness (**Appendix 1**).[9]

Results

The records of 28 dogs with shoulder related lameness that underwent ESWT were identified, and 15 of those met the inclusion criteria (**Table 1**). There were four mixed-breed dogs, three Australian shepherds, two Labrador retrievers, and one each of several other breeds. Mean age at diagnosis was 5.7 ± 2.7 yr (range, 1.8–11.4 yr).

Diagnosis was based on some combination of physical examination, radiography, ultrasonography, and/or arthroscopy of the shoulder. Five dogs were diagnosed with biceps tendinopathy, four with medial shoulder instability, three with supraspinatus tendinopathy, one with biceps and supraspinatus tendinopathy, one with medial shoulder instability and supraspinatus tendinopathy, and one with synovial osteochondroma. Median duration of lameness prior to treatment was 9 mo (range, 2–36 mo). Analysis of the data revealed the mean number of impulses/treatment was 1103 ± 340 (range, 750–1500) and the mean energy level of the impulse delivered was 0.24 ± 0.03 mJ/mm^2 (range, 0.21–0.26 mJ/mm^2).

Nine dogs returned for a final examination 3–4 wk after ESWT was completed. The lameness was improved in six of those nine dogs, and gait was normal in the remaining three dogs as assessed by a veterinarian. No complications following shockwave therapy were noted.

Eleven clients were available for telephone interviews, with a mean follow-up time of 844 ± 543 days (range, 120–1830 days). Four clients could not be reached for follow-up telephone interview. Seven out of 11 dogs (64%) were considered by their owners to be either better or normal. Three dogs were considered to have the same degree of lameness as pretreatment. The three dogs that were not considered by their owner to be improved had diagnoses of supraspinatus tendinopathy (n = 1), and medial shoulder instability (n = 2). One dog with bicipital tendinopathy was considered to be more lame 1080 days following treatment. That dog was also diagnosed with Lyme disease and became pregnant in the follow-up period.

Discussion

Treatment with ESWT was successful in either reducing or eliminating shoulder-related lameness in the majority of this cohort of dogs that were refractory to previous conservative management. All dogs that returned for their scheduled examinations 3–4 wk after treatment ended were either improved or free of lameness. That correlated with other studies that found ESWT to be successful in the treatment of a variety of tendinous injuries.[1,5,7,8] The effects of treatment were also durable because 64% of dogs either remained improved or were without lameness at long-term follow up.

Not all dogs were successfully treated in the long-term. That could either be due to a failure of ESWT to resolve their condition or may represent an inability of shockwave to treat some musculotendinous conditions of the shoulder. Specifically, dogs 4

TABLE 1

Dog	Dx	Age (yr)	Sex	Breed	Duration of lameness prior to tx	T1 Severity of lameness	T2 Lameness score*	T3 Lameness score*	Duration of follow up (yr)	Supplemental medications	Comments
1	R ST	7.33	CM	Rhodesian ridgeback	18 mo	NR	2	1	3.92	Deracoxib, previcoxib	—
2	Bilat BT	6	M	Mixed-breed dog	9 mo	NR	2	—	—	—	Unavailable for telephone interview, developed Lyme disease, became pregnant.
3	R BT	3.75	F	Welsh corgie	3 mo	NR	NA	0	3	—	Shoulder problem again 1 yr later.
4	L MSI	10.42	CM	Australian shepherd	3 mo	Severe	2	1	3.25	—	Improved angle of abduction
5	R MSI	4.42	CM	Australian shepherd	24 mo	NR	3	1	2.58	Tramadol	—
6	L ST	5.83	CM	Labrador retriever	36 mo	Moderate	2	—	—	Meloxican	Unavailable for telephone interview
7	R MSI	5	CM	Mixed-breed dog	24 mo	Moderate	2	—	—	Carprofen	Unavailable for telephone interview
8	L BT	11.58	CM	Australian shepherd	2 mo	NR	NA	3	1.67	—	—
9	L MSI	1.83	SF	Labrador retriever	5 mo	Mild	3	2	1.67	Tramadol	—
10	R BT	4.58	F	Golden retriever	7 mo	NR	NA	3	1.42	Previcox	—
11	L OS	5.08	CM	Mixed-breed dog	3 mo	NR	NA	—	0.33	Carprofen	Follow-up period too short
12	R ST and BT	7.5	SF	Mixed-breed dog	12 mo	Nonweight bearing	3	3	0.5	—	—
13	L BT	2	M	Collie	NR	NR	NA	2	2.25	—	Improvement after intra-articular corticosteroid
14	L ST	5.17	SF	Labradoodle	NRNR	NR	NA	2	2.25	—	—
15	L MSI and ST	6.25	SF	German shepherd dog	16 mo	Moderate	2	2	0.5	—	—

*0, worse; 1, same; 2, improved; 3, normal.
Bilat, bilateral; BT, bicipital tendinopathy; CM, castrated male; Dx, diagnosis; F, female; L, left; M, male; MSI, medial shoulder instability; NA, not available for recheck; NR, not recorded; OS, synovial osteochondroma; R, right; SF, spayed female; ST, supraspinatus tendinopathy; T1, time of diagnosis, T2, 3–4 wk after last treatment; T3, score of lameness based on telephone interview questionnaire.

and 5 (**Table 1**) that did not remain improved had medial shoulder instability and no further treatment or evaluation was performed. The persistent lameness could be explained by early healing followed by reinjury of the affected structures. For instance, if the healing tissue was not of sufficient strength, ongoing wear and tear may result in return of instability and symptoms. It is unclear from this cohort whether the response of therapy was due to an analgesic effect, reduction of laxity, healing of tissue, or a combination of effects.

The exact mechanisms of therapeutic action are unknown, but are thought to include direct stimulation of healing by neovascularization, disintegration of mineralization, initiation of inflammation, and/or analgesic effects.[1,2] Reports have demonstrated an analgesic effect of ESWT, which may account for the short-term improvements and failure of some dogs long-term.[3,6,10,11] It seems unlikely that resolution of mineralization alone would account for improvement as dogs in this cohort because nonmineralized tendinopathies also improved after ESWT. ESWT has been shown to stimulate neovascularization and upregulation of collagen synthesis in tendons, which could account for the long term-improvement seen in some dogs in this study.[2,12] The study authors believe that recent in vitro work demonstrating reduction of matrix metalloproteases found in diseased tenocytes may be responsible for the results seen with ESWT.[13] Specifically, matrix metalloproteinases

1, 2, and 13, as well as interleukin-6 were expressed in greater concentrations in diseased tenocytes, and ESWT reduced the concentration of those molecules to levels found in normal tenocytes. The reduction in cytokines responsible for collagen degradation in combination with stimulation of collagen synthesis may be the most likely reason for improvement in our cohort of dogs.

Lameness in dog 13 only improved after an intra-articular corticosteroid injection, which suggests that traditional therapies for bicipital tendinopathy should be considered either before novel therapies such as ESWT or after ESWT if poor response to treatment is evident. However, the majority of dogs with either a biceps or supraspinatus tendinopathy were successfully treated with ESWT showing promise for this therapy. When dogs were grouped by diagnosis, there were too few dogs in each group to allow meaningful comparison to confirm whether ESWT would be more successful for a particular problem.

There are several limitations to this case series. Some dogs were treated with either NSAIDs or tramadol during the treatment period, which may have contributed to either improvement or resolution of clinical signs. Although it would have been ideal if dogs received no medications during ESWT, the dogs in this cohort were treated after failure of chronic conservative management, including exercise restriction and/or analgesics. In addition, the 12–16 wk of exercise restriction during ESWT could have been responsible for the improvement in some dogs. However, if dogs were destined to improve following strict exercise restriction then the study authors would have expected them to improve with the previous period of conservative treatment. Previous conservative management was not standardized given the retrospective nature of the study. The study authors advised exercise restriction during and immediately after the ESWT treatment period because normal collagen structure is altered immediately after treatment, which could lead to biomechanical inferiority and further damage of the injured tendon or any adjacent structures.[12] In addition, healing tissues resulting from neovascularization and collagen synthesis require time to form and mature.

Treatment protocols for ESWT recommended in the literature vary considerably.[4–8] Three treatments were used in this study based on both current literature and manufacturer recommendations. Although neovascularization peaked at 4 wk in one study, collagen gene expression continued to be elevated for >6 wk after treatment in another study.[2,12] Both of those findings were after a single ESWT treatment, which demonstrates the lasting effects of ESWT. Dogs in this cohort may have been able to return to normal exercise levels with a shorter treatment protocol and shorter duration of exercise restriction. Further research is needed to determine the ideal number of treatments, number of impulses delivered per treatment, and success of ESWT for various ailments.

Conclusion

ESWT was well tolerated by all treated patients under heavy sedation, with minimal morbidity. Despite the limitations of the study, ESWT may be considered in dogs with lameness attributable to instability, calcifying, and inflammatory injuries of the shoulder that have not responded to traditional therapies. Prospective controlled trials are warranted to compare this treatment to others that are available.

FOOTNOTES

[a] Versatron 4 Paws; Pulse Veterinary Technologies, Alpharetta, GA

[b] Tramadol HCl USP; Caraco Pharmaceutical Laboratories, Detroit, MI

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APPENDIX 1

Telephone Questionnaire Used to Determine Outcome of Extraporeal Shockwave on Lameness*

Your dog had shockwave therapy over a 3-month period in _____. The last shockwave treatment was on _____. All the answers to these questions should reflect activity/mood of your dog today.

1. How is the mood of your dog? (Did he seem happy, sad, etc?)
   Worse Same Better Normal

2. How is the attitude of your dog as compared to one month before starting treatment? (Did he or she seem happy, sad, etc.?)
   Worse Same Better Normal

3. What is the willingness of your dog to play voluntarily? (Is your dog eager to play like it did before injury or does it refrain from play?)
   Worse Same Better Normal

4. How is the frequency of exercise? (Was your dog exercising as much as before injury or still keeping quiet?)
   Worse Same Better Normal

5. How would you characterize your dog's stiffness when rising for the day?
   Worse Same Better Normal

6. How would you characterize your dog's stiffness at the end of the day?
   Worse Same Better Normal

7. How is your dog at a walk? (Was your dog as lame while walking or after walking for a bit?)
   Worse Same Better Normal

8. How is your dog during playing? (Was your dog as lame while walking or after walking for a bit?)
   Worse Same Better Normal

*Modified from Hudson et al. (2004).[8]