

Efficacy, Safety, and Tolerability of Intra-Articular Injection with 2.5% Polyacrylamide Hydrogel in 18 Dogs with Elbow Osteoarthritis

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Reasons for performing the study:

Osteoarthritis (OA) is estimated to affect as many as 57% of dogs in the United States (1). Intra-articular (IA) therapy is becoming more attractive due to its perceived efficacy and low risk of adverse events (2). 2.5% injectable polyacrylamide hydrogel (2.5% iPAAG) is a novel injectate that has demonstrated a favorable safety profile, high tolerability, and long-lasting efficacy in horses and humans with OA (2). However, research in dogs is lacking.

Objective:

The objective of this prospective clinical study is to evaluate the efficacy, safety, and tolerability of 2.5% iPAAG in dogs with elbow OA using the Canine Brief Pain Inventory Pain Interference Score (CBPI PIS), modified Glasgow Composite Pain Scale (mGCPS), lameness (Numerical Rating Score, NRS), and elbow goniometry. We hypothesized that IA 2.5% iPAAG would improve pain and function scores with minimal adverse events.

Methods:

Inclusion criteria included thoracic limb lameness, unilateral or bilateral elbow OA confirmed by computed tomography (CT), and CBPI PIS ≥ 4 . Exclusion criteria included the following: pregnant or lactating females; new treatment with systemic analgesic or anti-inflammatory drugs within 30 days; oral corticosteroid or anti-NGF use within 3 months; intra-articular use of corticosteroid, platelet rich plasma, collagen-elastin microparticles, or hyaluronic acid in the elbow(s) within 6 months; Sn-117m injection in the elbow(s) within 12 months; any history of stem cells or 2.5% iPAAG injection in the elbow(s); arthroscopy/surgery of the elbow(s) within 3 months; and infection of the elbow joint(s) or surrounding soft tissues/skin. Patients were of low anesthetic risk and placed under general anesthesia. CT of both thoracic limbs was performed and evaluated by a board-certified radiologist. Pending results, unilateral or bilateral IA elbow injections with 1mL of 2.5% iPAAG were performed by a board-certified sports medicine specialist. On day 1, owners were contacted by phone to monitor adverse events. Patients were examined on days 0, 14, 28, 56, and 84 by a board-certified sports medicine specialist. Complete blood count and

serum biochemistry were performed at days 0 and 84. All data was analyzed using SPSS 29.0 (Armonk, NY: IBM Corp). There was no interaction between elbow sides (left and right) for range of motion measured using goniometry; thus, the data was collapsed into a single variable for flexion and extension. Means, 95% confidence intervals, and effect size (partial eta²) were calculated for all data sets.

Results:

All 18 patients completed days 0-84. Average patient age was 7.2 ± 2.9 years (range: 2-11 years) and average weight was 31.9 ± 8.8 kg (range: 20.4-49.9 kg). Nine patients were spayed females; 9 patients were neutered males. Fifteen dogs received bilateral elbow injections, and 3 dogs received unilateral injections (1 left, 2 right). There were 5 Golden Retrievers, 4 Labrador Retrievers, 2 mixed breed dogs, and 1 each of Labrador mix, German Shepherd, German Shepherd mix, English Bulldog, Newfoundland, Husky, and American Staffordshire. In the first 84 days, CBPI PIS, mGCPS, NRS, and goniometry were evaluated. There was a statistically significant effect in all datasets from Day 0-84 ($p < 0.001$) with the greatest improvement seen in the first 28 days. Statistical significance varied across time points for all measurements, as illustrated in Figures 1-5. Corresponding p-values for each dataset and time point are presented in Table 1. From Day 0-84, there was an overall effect size (partial eta²) of 0.47, 0.73, 0.83, 0.81, and 0.72 for CBPI PIS, mGCPS, NRS, elbow flexion, and elbow extension, respectively (Table 2). Adverse events were seen in 2 dogs. One patient experienced pain, bruising, and swelling of the injection sites on both elbows on Day 14, which resolved by Day 28. Another patient developed mild azotemia between days 0 and 84, but this was determined to be unrelated to the injection. No other clinically significant blood work changes were observed throughout the study period.

Tables 1 & 2

Time Interval	CBPI PIS	mGCPS	NRS	Elbow Flexion	Elbow Extension
Day 0-14	$p < 0.0002^*$	$p < 0.001^*$	$p = 0.01^*$	$p < 0.0$	$p < 0.0$
Day 14-28	$p < 0.026^*$	$p < 0.06$	$p = 0.01^*$	$p < 0.0$	$p < 0.0$
Day 28-56	$p < 0.177$	$p = 0.14$	$p = 0.74$	$p = 0.35$	$p = 0.07$
Day 56-84	$p < 0.16$	$p = 0.53$	$p = 0.14$	$p = 0.6$	$p = 0.74$

This table shows the p-values calculated for each dataset at each timepoint. The asterisk (*) indicates statistically significant values.

Variable	CBPI PIS	mGCPS	NRS	Elbow Flexion	Elbow Extension
Effect size (partial eta ²)	0.47	0.73	0.83	0.81	0.72
Significance	$p < 0.001$	$p < 0.001$	$p < 0.001$	$p < 0.001$	$p < 0.001$

This table shows main effect (partial eta²) and significance for each dependent variable over Days 0-84.

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Discussion:

These results demonstrate that IA 2.5% iPAAG injection is a safe and effective treatment option for the management of canine elbow OA. The few reported adverse events confirm that 2.5% iPAAG is safe when aseptic technique is maintained due to its inert and biocompatible properties (2). The improvement in goniometry, lameness, and pain scores is likely multifactorial in nature. Based on research with equine and caprine models, it appears 2.5% iPAAG improves elasticity of the joint capsule (2), thus reducing discomfort upon range of motion. 2.5% iPAAG may provide viscosupplementation, which could account for the dramatic improvement in pain scales and goniometry in the first 2 weeks post-injection. Continued improvement over time corresponds with 2.5% iPAAG adsorption into the synovial membrane, resulting in a transient hypercellular environment with macrophages and surface synoviocytes, villous hyperplasia, and improved vascularity (3).

Study limitations:

There was no control group to compare between treatment and non-treatment groups. Authors were unable to incorporate objective gait analysis due to lack of availability/equipment, creating the possibility of inaccuracy or increased variability in results. It is unknown whether increasing patient size reduced efficacy of the injection or longevity of results. Similarly, because patients were not categorized by grade, we were unable to determine whether outliers responded less due to advanced OA. Future studies are warranted to assess degree of improvement based on severity of disease and to investigate dosages proportionate to patient size/synovial space.

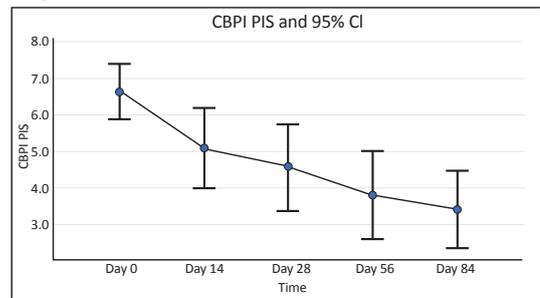
Scientific or clinical relevance:

This study supports the use of 2.5% iPAAG in the treatment of canine elbow OA, making it an option for clients seeking to reduce their pets' pain and improve mobility and quality of life.

References

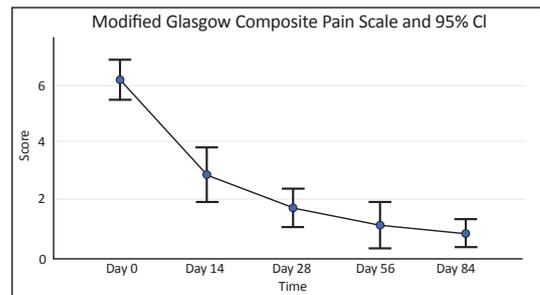
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Figure 1



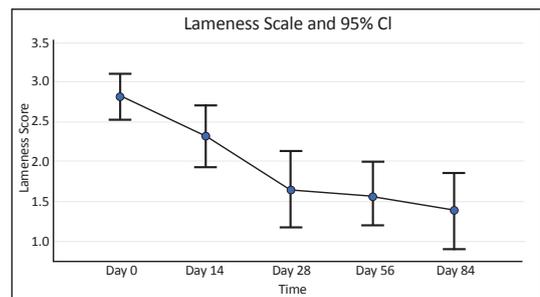
Avg. Canine Brief Pain Inventory (CBPI) scores for all patients over days 0-84.

Figure 2



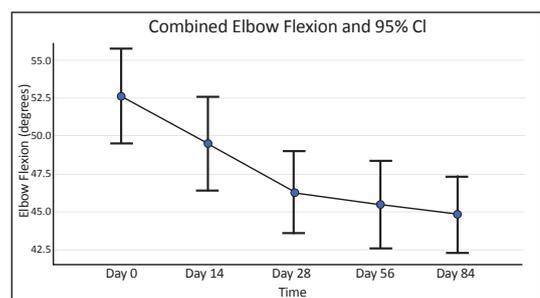
Avg. total modified Glasgow Composite Pain Scale (mGCPS) for all patients over days 0-84.

Figure 3



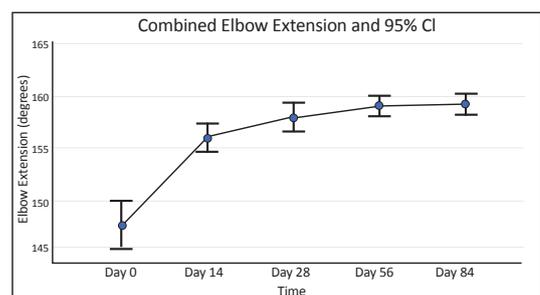
Avg. lameness grade (Numerical Rating Score) for all patients from days 0-84.

Figure 4



Avg. combined (left and right) elbow flexion for all patients from days 0-84.

Figure 5



Avg. combined (left and right) elbow extension for all patients from days 0-84.