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Research Article

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Impact of a Glycosaminoglycan and Type II Collagen Supplement (Glycosane®) On Mobility and Quality of Life in Senior Dogs: A Pet-Owner Evaluation

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Abstract

As dogs age, the decline in mobility is a common physiological change. The incorporation of complementary feeds can be an effective strategy to support and preserve joint function and mobility, contributing to the maintenance of overall musculoskeletal health and comfort in geriatric dogs. Privately owned dogs aged over six years, exhibiting reduced mobility and no changes in their mobility management within the last three months, were recruited for this study. They were administered a chicken cartilage hydrolysate complementary feed containing a complex of glycosaminoglycans and type II collagen (Glycosane®, MP Labo, France) once daily for 56 days. Assessments were conducted at baseline (D0) and follow-up visits at D7, D28, and D56. Mobility, pain intensity, and pain interference were evaluated using a revised Liverpool Osteoarthritis in Dogs (LOAD) scale and a Canine Brief Pain Inventory (CBPI). Owners also completed a questionnaire assessing quality of life (QoL), with seven questions on the animal's well-being (QoL1) and seven questions on the owner's well-being (QoL2). A total of 21 dogs were included in the study, with 71% of owners reporting enhanced mobility by D56. Notable improvements were observed in half of the cases after 21 days of supplementation, with 39% of cases showing significant changes as early as 14 days. Revised LOAD scores demonstrated a significant improvement over time ($p=0.0019$). CBPI severity scores decreased significantly from baseline to D28 and D56 ($p=0.0300$ and $p=0.0271$, respectively). The CBPI QoL score also significantly improved at D56 compared to D7 ($p=0.0440$). The overall QoL score showed a significant improvement by D56 compared to baseline ($p=0.0089$), with a particular improvement in QoL1 ($p=0.0015$). The supplement was rated highly for ease of use (mean score 4.4/5), with an excellent compliance (95%). This complementary feed demonstrates significant benefits in enhancing mobility and quality of life in senior dogs. Its high ease of administration supports owner compliance and satisfaction. These findings suggest that Glycosane® is a valuable nutritional aid in maintaining canine mobility. Further studies with larger cohorts and a controlled group are recommended to confirm these results.

Keywords: Glycosane, Canine Mobility, Complementary Feed, LOAD, CBPI, Quality of Life

Abbreviations

CBPI: Canine Brief Pain Inventory

Ca OA-QoL-TS: Canine OA Quality of Life and Treatment Satisfaction Questionnaire

Dx: Day X

LOAD: Liverpool Osteoarthritis in Dogs

OA: Osteo Arthritis
QoL: Quality of Life

1. Introduction

Osteoarthritis (OA) is a highly prevalent degenerative joint disease in dogs, particularly affecting the senior population. Studies indicate that approximately 20% of adult dogs suffer from OA, with prevalence increasing to over 80% in geriatric dogs [1]. Graves et al. demonstrated that older age, higher adult body weight, and neutering are statistically significantly associated with higher risks of OA in this cohort [2]. Large and giant breeds, such as Labradors and German Shepherds, are disproportionately affected, often due to genetic predisposition, conformation issues, or excessive joint loading [2,3]. However, smaller breeds can also be affected. For example, Pomeranians, Chihuahuas, Yorkshire terriers, and French Bulldogs have higher odds of developing patellar luxation compared to crossbreeds, which could lead to OA [4]. Furthermore, the disease is exacerbated by factors such as obesity, age, prior trauma, and joint instability, resulting in a progressive deterioration of articular cartilage and associated inflammation of the surrounding tissues.

OA is characterised by a breakdown of type II collagen and proteoglycans, leading to cartilage erosion and the formation of osteophytes in the subchondral bone [5,6]. This process triggers pain, stiffness, and reduced mobility, which significantly impair a dog's ability to perform routine activities like walking, running, or climbing stairs [7]. Pain management is particularly challenging, as OA involves both nociceptive and neuropathic pain pathways, creating a need for multimodal treatment strategies [8].

As a degenerative joint disease, OA leads to reduced mobility, which not only impairs the affected dog's health but also impacts the emotional and physical well-being of their owners [7]. A dog's quality of life (QoL) is closely tied to physical activity, with chronic joint pain often resulting in diminished engagement in daily activities such as walking, running, or playing [9]. This decline in mobility often sets in motion a cycle of reduced activity, muscle atrophy, and further joint dysfunction [10]. From an owner's perspective, witnessing the progressive decline of their pet's mobility and comfort can be emotionally distressing, often accompanied by increased caregiving responsibilities and financial burdens. The impact of chronic diseases, such as OA or atopic dermatitis, extends beyond the animal, affecting the emotional and physical well-being of owners, who often experience stress, financial strain, and emotional distress due to their pet's declining health [11,12].

Given the chronic nature of OA, long-term management relies on a combination of pharmacological treatments, such as NSAIDs or monoclonal antibodies, and adjunctive therapies, including weight control, physiotherapy, and nutritional supplements [8]. Feed supplements have gained prominence as part of a multimodal approach to OA management, offering a beneficial adjunct to pharmacological treatments. For instance, Pye et al. underscored the benefits of non-pharmaceutical options for canine OA, such as weight management and nutraceuticals including omega-3 fatty acids [13]. Among the various ingredients used in feed supplements, type II collagen, a primary structural component of cartilage, has been shown to reduce the production of pro-inflammatory cytokines, and promote cartilage repair [14]. In a recent meta-analysis, collagen formulations received a positive efficacy score, though it was the weakest among four categories, largely due to small sample sizes, use of non-validated subjective assessment tools, inadequate statistical methodologies, and limited follow-up periods [15]. Glycosaminoglycans, including chondroitin sulphate and glucosamine, provide essential substrates for proteoglycan synthesis and improve joint lubrication, contributing to enhanced joint health and reduced inflammation [16-18].

This study aimed to evaluate the effects of a complementary feed containing a chicken cartilage hydrolysate, which includes glycosaminoglycan complexes and type II collagen, on the mobility and quality of life of geriatric dogs with reduced mobility, using adapted validated clinical metrology instruments, such as the Liverpool Osteoarthritis in Dogs (LOAD) scale and the Canine Brief Pain Inventory (CBPI).

2. Methods

Animals: Privately owned dogs over the age of six years were recruited for this study. Inclusion criteria required that the dogs exhibited reduced mobility and had not received any changes in their mobility management, such as treatments, supplements, or therapies, in the previous three months. Reduced mobility was defined as the presence of at least two mobility impairments, including difficulty rising from a lying position, walking difficulties, trouble climbing stairs or jumping, and pain during limb mobilization.

Product: The dogs received a chicken cartilage hydrolysate complementary feed containing a complex of glycosaminoglycans and type II collagen (Glycosane®, MP Labo, France). The recommended quantity was one capsule per dog weighing up to 40 kg, and two capsules for dogs over 40 kg. The supplementation was administered orally, once daily, for 56 consecutive days.

Evaluations: Assessments were performed by the owners at baseline (D0), and at follow-up time points of D7, D28, and D56.

Mobility: The primary outcome was assessed using the Liverpool Osteoarthritis in Dogs (LOAD) scale [19,20]. This 13-item scale measures mobility impairment related to osteoarthritis. Each item is rated on a 5-point scale (0-4, with 0 meaning "no problems" and 4 "meaning severe problems"). The total score represents the sum of individual item scores, with higher values indicating greater discomfort and functional limitation (Figure 1).

	0	1	2	3	4
How is your dog's mobility in general?	Very good	Good	Fair	Poor	Very poor
How disabled is your dog by his/her lameness?	Not at all disabled	Slightly disabled	Moderately disabled	Severely disabled	Extremely disabled
How active is your dog?	Extremely active	Very active	Moderately active	Slightly active	Not at all active
What is the effect of cold, damp weather on your dog's lameness?	No effect	Mild effect	Moderate effect	Severe effect	Extreme effect
To what degree does your dog show stiffness in the affected leg after a 'lie down'?	No stiffness	Mild stiffness	Moderate stiffness	Severe stiffness	Extreme stiffness
At exercise, how active is your dog?	Extremely active	Very active	Fairly active	Not very active	Not at all active
How keen to exercise is your dog?	Extremely keen	Very keen	Fairly keen	Not very keen	Not at all keen
How would you rate your dog's ability to exercise?	Very good	Good	Fair	Poor	Very poor
What overall effect does exercise have on your dog's lameness?	No effect	Mild effect	Moderate effect	Severe effect	Extreme effect
How often does your dog rest (stop/sit down) during exercise?	Never	Hardly ever	Occasionally	Frequently	Very frequently
What is the effect of cold, damp weather on your pet's ability to exercise?	No effect	Mild effect	Moderate effect	Severe effect	Extreme effect
To what degree does your dog show stiffness in the affected leg after a 'lie down' following exercise?	No stiffness	Mild stiffness	Moderate stiffness	Severe stiffness	Extreme stiffness
What is the effect of your dog's lameness on his/her ability to exercise?	No effect	Mild effect	Moderate effect	Severe effect	Extreme effect

Figure 1: LOAD Scale [19]

Pain: Pain was assessed using a revised version of the Canine Brief Pain Inventory (CBPI), adapted from its original and French versions [9,21]. The CBPI consists of two main components: the severity of pain (rated on a 0–10 scale) and the degree of pain interference with daily activities (also rated on a 0–10 scale). Two sub-scores (pain severity and pain interference) were calculated by summing the individual scores for each component. Additionally, a quality-of-life (QoL) score was derived from the overall impact of pain on the dog's daily life. The scale was modified from the original one as question 6 (Pain's interference with enjoyment of life) was not asked (Figure 2).

Section	Question	Possible Answers (Scale 0-10)
Pain severity	1. Pain at its worst in the last 7 days	0 = No pain, 10 = Extreme pain
	2. Pain at its least in the last 7 days	0 = No pain, 10 = Extreme pain
	3. Pain on average over the last 7 days	0 = No pain, 10 = Extreme pain
	4. Pain as it is right now	0 = No pain, 10 = Extreme pain
Pain interference	5. Pain's interference with general activity	0 = Does not interfere, 10 = Completely interferes
	6. Pain's interference with the ability to rise to standing from lying down	0 = Does not interfere, 10 = Completely interferes
	7. Pain's interference with the ability to walk	0 = Does not interfere, 10 = Completely interferes

	8. Pain's interference with the ability to run	0 = Does not interfere, 10 = Completely interferes
	9. Pain's interference with the ability to climb stairs, curbs, doorsteps, etc.	0 = Does not interfere, 10 = Completely interferes
Overall Impression	10. Overall quality of life over the last 7 days	0 = Poor, 1-3 = Fair, 4-6 = Good, 7-9 = Very Good, 10 = Excellent

Figure 2: Revised CBPI [9,21]

Quality of Life: Owner-reported QoL measures were used to assess both the well-being of the dog and the owner. Adapted from Noli et al. the questionnaire included 14 items: 7 items assessed the dog's well-being (QoL1) and 7 addressed the owner's well-being (QoL2). Each item was scored on a 0-3 scale (0 = Not at all, 1 = A little, 2 = Quite a bit, 3 = Very much). The individual scores for QoL1 and QoL2 were summed to calculate a total QoL score [12]. Question 1 from the original version (How severe and disturbing has your dog's disease been?) was not included in our revised scale. (Figure 3).

	Questions
QoL 1: dog's well-being	What was the impact of your dog's disease on its behaviour and/or mood? (More lazy, more nervous, more aggressive, etc.)
	How much was your dog's sleep disturbed by the disease?
	How much were your dog's meals disturbed by the disease? (It has no appetite, it scratches during meals, it does not like special food, etc.)
	How much were your dog's playing or working activities disturbed by the disease? (It is more lazy, nervous, itchy, etc.)
	What was the impact of your dog's disease on its relationship with you, the other family members or other dogs? (Due to mood changes, presence of skin lesions, etc.)
	How much has your dog's disease changed its usual habits? (Change in place where he is allowed to sleep, live, eat, way in which it is walked, etc.)
	How much was the dog disturbed by the administration of therapies (Shampoos, sprays, tablets, injections, ear cleaning and drops, etc.)
QoL 2: owner's well-being	How much time did you lose for your dog's disease? (Administration of therapies, shampooing, home cleaning, cooking, veterinary consultations, etc.)
	How much effect had your dog's disease on your tiredness? (Extra cleaning, cooking, shampooing, etc.)
	How much were your usual activities and/or those of your family disturbed by your dog's disease? (Leisure, vacation, walks, work, hunting, etc.)
	How much impact did your dog's disease have on your expenditure? (Cost of treatment, veterinarian, etc.)
	How much effect did your dog's disease have on causing emotional distress? (Feeling of guilt, powerlessness, sorrow, regret, anxiety, nuisance, disgust, anger, frustration, etc.)
	How much physical uneasiness/discomfort did you experience due to your dog's disease? (Offending odour, feeling of dirtiness at home, aesthetic nuisance, etc.)
	How much impact did your dog's disease have on the relationship between family members? (Between spouses, between parents and sons, with relatives and friends, etc.)

Figure 3: Revised QoL Questionnaire [12]

Statistics: Mixed models for repeated measures were applied to assess the changes in mobility, pain, and QoL scores over time. Dunnett's multiple comparison tests were used for post-hoc analyses: data from each assessment time point (D0, D7, D28, and D56) were analysed to evaluate the effect of the intervention, with a focus on comparing baseline data (D0) to the follow-up data. A significance level of $p < 0.05$ was set for all tests.

3. Results

Dog's Population: A total of 21 privately owned dogs were included in the study, with an average age of 10.2 years (+/- 2.9), ranging from 6.0 to 14.5 years. The population included 29% mixed-breed dogs and 12 different pure breeds, with Shih Tzus being the most common (14%). Each of the other pure breeds accounted for 5% of the population. The average body weight of the dogs was 17.3 kg (+/- 13.3), ranging from 2.3 kg to 49.0 kg. The majority of the dogs were male (65%), with 35% female, and all females were spayed, while 85% of males were neutered. The dogs had an average body condition score of 5.0 (+/- 1.0) on a scale from 1 to 9, indicating that most of the dogs were of normal weight, with scores ranging from 3.0 to 7.0. The average duration of mobility issues prior to the study was 1.9 years (+/- 2.0), with

a range from 2.4 months to 7.5 years. At the time of inclusion, only two dogs were receiving products for mobility, consisting of complementary feeds: one with glucosamine and chondroitin and the other with Devil's Claw, although no changes had been made to their treatment in the two months prior to the study. At inclusion, the majority of dogs presented three (43%) or four (38%) clinical signs of mobility impairment, while 19% presented two signs.

Mobility Scores: A significant improvement in LOAD scores was observed over time (Mixed model, $p = 0.0019$), with a significantly decreased score on D56 (20.72 +/- 10.03) versus D0 (28.14 +/- 6.47) (Dunnett's test, $p = 0.0434$). Seventy-one percent of owners reported enhanced mobility by Day 56.

Pain Evaluation: The Canine Brief Pain Inventory (CBPI) severity scores demonstrated a significant decrease over time (mixed model, $p = 0.0209$). It decreased from baseline to Day 28 (Dunnett test, $p = 0.0300$) and Day 56 (Dunnett test, $p = 0.0271$), indicating a reduction in pain intensity (Figure 4). There was no statistically significant difference in the evolution of the CBPI interference score over time (mixed model, $p = 0.2294$). Additionally, the CBPI Quality of Life score improved significantly by Day 56 (3.9 +/- 0.83) compared to Day 7 (3.39 +/- 0.70 (Dunnett's test, $p = 0.0440$) (mixed model, $p = 0.0103$). The question was missing on D0 and could not be evaluated.

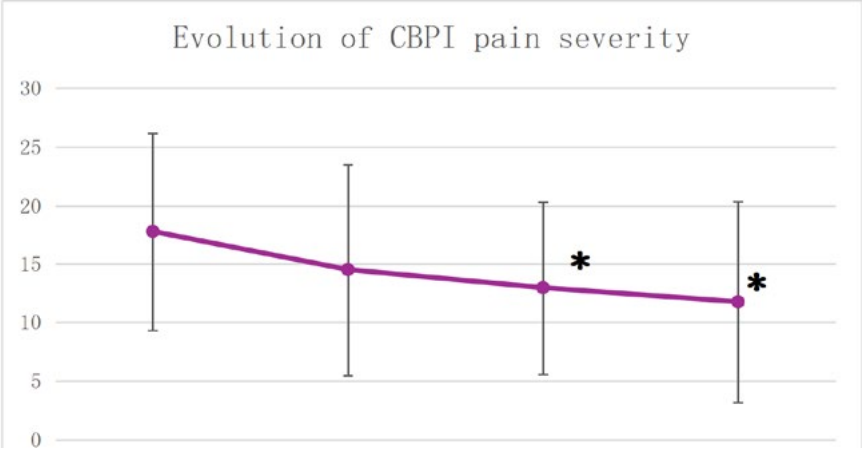

Figure 4: CBPI Pain Severity Score (mean and standard deviation). *Denotes Statistical Differences Versus D0 ($p<0.05$)

Quality of Life: A significant improvement in the overall QoL score was observed by Day 56 compared to baseline (Dunnett's test, p=0.0089), with a marked improvement in the QoL1 score, which reflects the animal's well-being. The QoL1 score decreased significantly from D0 (7.4+/- 5.4) to D56 (4.6 +/- 4.2) (mixed model, p=0.0015). The QoL2 score did not significantly improve.

Product Evaluation: The ease of use of the feed supplement was rated highly by owners, with an average score of 4.4/5, and compliance was excellent, with 95% of owners adhering to the daily supplementation regimen. The most cited benefits included an increased willingness to walk (19%), enhanced activity levels, improved ability to run or jump from short heights, and overall increased happiness in dogs (11%). A high proportion of owners (78%) noted enhanced comfort in their dogs, and 79% reported an improvement in their dogs' happiness, with 60% perceiving a restoration of good mobility. Notably, owners reported improvements in 50% of the dogs by Day 21, with 39% showing noticeable changes as early as Day 14.

4. Discussion

The results of this study demonstrate significant improvements in mobility, pain severity scores and quality of life among senior dogs supplemented with Glycosane®, as assessed using validated tools like LOAD and revised CBPI. By day 56, LOAD scores exhibited statistically significant reductions, indicating enhanced mobility, while CBPI severity score also decreased, reflecting reduced discomfort. Additionally, improvements in owner-reported QoL1 score highlight the broader impact of enhanced mobility on the dog-owner bond.

These results align with previous research showing the benefits of type II collagen and glycosaminoglycans in supporting joint health [22]. The inclusion of type II collagen, a key component of the synovial joint matrix, provides a biologically relevant mechanism for cartilage support [5]. Previous studies have highlighted the role of collagen peptides in maintaining joint health by promoting cartilage integrity and enhancing the synthesis of key matrix components such as type II collagen and aggrecan in chondrocytes. Hydrolysed collagen has been shown to enhance proteoglycan synthesis, increase aggrecan gene expression, and stimulate type II collagen production in bovine and porcine articular chondrocytes [23]. Evidence further suggests that collagen exerts a stimulatory effect on type II collagen biosynthesis in chondrocytes, indicating a potential feedback mechanism that helps regulate collagen turnover within cartilage tissue [24]. Moreover, collagen has demonstrated the ability to enhance the synthesis of both proteoglycans and type II collagen, supporting anabolic processes that may counteract degenerative changes in the extracellular matrix of cartilage tissue [25]. A later study confirms that collagen peptide supplementation reduces catabolic processes, significantly decreasing inflammatory cytokines and proteases in canine chondrocytes, while improving

the biosynthesis of type II collagen, elastin, and aggrecan [14]. These findings were further consolidated by a double-blind, placebo-controlled trial in dogs: oral administration of a protein derived from collagen (gelatin hydrolysate) over eight weeks resulted in significant improvements in activity levels and marked reductions in stiffness among dogs exhibiting signs of osteoarthritis [26]. Glycosaminoglycans, including chondroitin and glucosamine, further support cartilage health by helping to stimulate proteoglycan synthesis and to reduce matrix degradation [18].

Despite these promising findings, certain limitations should be addressed. First, the modified version of CBPI used in this study omitted one parameter from their original validated versions, potentially impacting the comprehensiveness of the assessments [9]. For example, the exclusion of a detailed interference subdomain, such as overall enjoyment of life, may limit the tool's sensitivity to subtle changes in the dogs' daily activities. This omission could potentially underestimate the full impact of the feed supplement on pain-related behaviours. To ensure greater accuracy, future studies should aim to include the complete, validated versions of these tools [21,27].

As highlighted in recent research, chronic diseases like OA not only impact canine QoL but also significantly affect owner QoL, encompassing emotional well-being, physical functioning, and social interactions, as owners adapt their lifestyles to manage caregiver burdens [28]. Assessing QoL in the context of mobility issues is crucial, as it enables a comprehensive evaluation of how a dog's mobility and comfort influence both the animal and its owner. In our study, a significant improvement in the Qo L1 subscore was observed and corroborated by the QoL question results in the CBPI questionnaire. However, the QoL questionnaire, while adapted from validated dermatological tools, has not been explicitly validated for OA contexts. Since dermatological conditions and OA uniquely affect animal behaviour and activity levels, further investigation is needed to confirm the transferability of these metrics [9,12]. Recently, OA-specific tools like the Ca OA-QoL-TS (Canine OA Quality of Life and Treatment Satisfaction Questionnaire) have been developed, offering a validated, multi-dimensional approach to measure the QoL of both dogs and their owners, showcasing their utility in evaluating treatment outcomes and guiding veterinary interventions [11]. Unfortunately, this tool was not available at the time of the study.

Another limitation lies in the study's relatively small sample size (21 dogs), which may reduce the generalizability of the results to larger populations. Future studies involving larger cohorts and incorporating control groups are necessary to validate these findings and explore the long-term efficacy of the feed supplement.

Nonetheless, this study presents several strengths. The high levels of owner-reported satisfaction, as evidenced by compliance rates (95%) and positive feedback on mobility improvements, underscore the practicality and acceptability of the product. It aligns with the growing emphasis on owner-friendly treatment solutions in veterinary medicine. Factors influencing adherence to and compliance with therapeutic regimens include the cost and accessibility of medications, the number of drugs administered, the frequency and duration of drug administration, the complexity of the treatment regimen, and the abilities of those administering the drugs - such as applying eye drops to pets or administering oral medications to cats [29]. A study by Boda et al. emphasizes that simplifying dosing regimens can enhance owner compliance [30]. The research indicates that reducing the frequency of medication administration improves adherence, leading to better health outcomes for pets. For instance, in cases of canine otitis externa, owner compliance increased from 21% to 79% when the topical medication was administered once daily instead of twice. This finding underscores the importance of user-friendly treatment protocols in veterinary care. Furthermore, the product's fixed quantity to administer (one capsule up to 40 kg, once a day) simplifies administration for owners, possibly enhancing compliance and mobility care consistency. This contrasts with weight-based regimens that may complicate dosing, especially for multi-pet households. In their study designed to validate the CaOA-QoL-TS, Gildea et al. showed that this instrument acknowledges the critical role of owner satisfaction and compliance in the effective management of canine OA, emphasizing the need for treatment regimens that are manageable for pet owners [24]. These studies collectively highlight the growing emphasis on owner-friendly treatment solutions in veterinary medicine, demonstrating that simplified and acceptable treatment regimens can lead to higher compliance rates and improved outcomes in canine OA management.

Evaluations were made by the owners. In human medicine, the unique value of patient-reported outcomes (PROs) in clinical trials has been highlighted, particularly for evaluating well-being outcomes that may not be fully captured by traditional clinical measures. PROs provide a critical perspective that reflects the patient's - or in veterinary contexts, the pet owner's – experience [31]. By relying on pet-owner evaluations in our study, we aimed to deepen the understanding of the product's impact and support more informed decision-making. However, the evidence-based approach recommends performing trials with veterinary measurements. In a randomised, double-blinded, controlled clinical trial evaluating the effects of dietary supplementation with fish oil omega-3 fatty acids on weight bearing in dogs with osteoarthritis, dogs fed the test food showed significant improvements in weight bearing and lameness, indicating the benefits of such supplementation in OA management. Additionally, Fritsch et al. performed a dose-titration study assessing the effects of fish oil in osteoarthritic dogs [32,33]. The research demonstrated that increasing the amount of fish oil in the diet resulted in dose-dependent increases in serum EPA and DHA concentrations and modest improvements in the clinical signs of OA in pet dogs.

To address the study's limitations, future research should employ larger, randomised controlled trials and validate the adapted QoL tools specifically for OA contexts. Incorporating objective measures such as force plate gait analysis or accelerometry would provide

additional layers of data to complement owner-reported outcomes. Additionally, exploring the synergistic effects of Glycosane® with other management strategies, such as physiotherapy, monoclonal antibodies or NSAIDs, could yield insights into optimising multimodal OA care.

5. Conclusion

The use of Glycosane®, which combines glycosaminoglycans and type II collagen, offers a promising avenue for supporting joint metabolism and cartilage integrity. The complementary feed demonstrates significant benefits in enhancing mobility and quality of life in senior dogs. Its high ease of administration supports owner compliance and satisfaction. Moreover, the positive outcomes observed in this study provide an encouraging foundation for integrating such products into the comprehensive management of canine mobility. However, to confirm these findings, further studies with larger cohorts and a controlled group are recommended, along with the inclusion of objective measures and long-term follow-up to assess sustained efficacy.

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