

INVITED REVIEW

Rehabilitation Therapy for Elbow Disorders in Dogs

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INTRODUCTION

THORACIC LIMB lameness caused by elbow pathology occurs commonly in dogs. The etiopathogenesis and surgical management for elbow disorders are well documented; however, recommendations and protocols for rehabilitation therapy after surgical intervention are not well described.

Rehabilitation after elbow injury or elbow surgery follows a sequential and progressive multiphased approach with the ultimate goal being to return the dog to its previous functional level as quickly and safely as possible. Several key principles must be addressed when rehabilitating the elbow: (1) the effects of immobilization must be minimized, (2) healing tissue must not be overstressed, (3) the dog must fulfill certain criteria throughout the phases of rehabilitation, (4) the program must be based on current scientific and clinical research, (5) the process must be adaptable to each dog and their specific goals, and (6) the rehabilitation program must be a team effort between the surgeon, rehabilitation therapists, owner, and dog. Communication between each team member is essential to successful outcomes.

Rehabilitation therapy typically includes a combination of techniques such as cryotherapy, other adjunctive modalities, manual therapies, and a home exercise program. Rehabilitation therapy is used to help decrease postoperative pain and inflammation, restore range of motion (ROM), improve muscle strength and condition, and return to function. Improved muscle strength and

ROM will help to provide long-term pain relief as well as better overall function of the limb and improved quality of life.

The following phases of a rehabilitation program are meant to serve as a general guideline (flow chart, Appendix A). Each case is uniquely different and factors including duration of injury/lameness before surgery, secondary osteoarthritic conditions, and type of surgical intervention, all influence the rate of healing and return to function.

Phase 1—Immediate Motion Phase (Weeks 1–3)

The goals of this phase are to minimize the effects of immobilization, protect healing tissue, reestablish non-painful ROM, decrease pain and inflammation, restore weight bearing, and retard muscular atrophy.^{1–9} The rehabilitation therapist must not overstress healing tissues or implants during this phase. It is important that the owner restrict the dog's activity to avoid running, jumping and rough play, and to engage in short leash walking only.

Manual Therapy. Early ROM activities are performed to nourish the articular cartilage and assist in the synthesis, alignment, and organization of collagen tissue. ROM is performed on the entire forelimb (toes, carpus, elbow, and shoulder; Fig 1) with slow controlled movement and slight over pressure at end range. ROM activities are usually performed 2–3 times daily and are performed for all planes of elbow and carpus motions to

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Fig 1. Phase 1 manual therapy. Passive range of motion of the elbow and carpus.

prevent formation of scar tissue and adhesions. Reestablishing full-elbow extension is the primary goal of early ROM activities to minimize the occurrence of elbow flexion contractures.¹⁰⁻¹² The elbow is predisposed to flexion contractures because of the intimate congruency of the joint articulations, the tightness of the joint capsule, and the tendency of the cranial aspect of the joint capsule to develop adhesions after injury. The biceps/brachialis complex also attaches to the capsule and crosses the elbow joint before becoming a tendinous structure and inserting on the ulnar tuberosity. Injury to the elbow may cause excessive scar tissue formation of the brachialis muscle as well as functional splinting of the elbow.

Grades I and II joint mobilizations (Fig 2) may be performed during the early phase of rehabilitation as tolerated by the dog.¹³ Joint mobilizations increase circulation, proprioception, healing, and decrease inflammation. Caudal glides with oscillations are performed in the midrange of motion to assist in restoration of full-elbow extension. Aggressive mobilization techniques are



Fig 2. Phase 1 manual therapy. Joint mobilizations of the elbow.

not used until later stages of rehabilitation when pain has subsided. Grades I and II mobilization techniques are also used to neuromodulate pain by stimulating type I and type II articular receptors.^{13,14} Joint mobilizations should also be performed to all joints that are hypomobile or restricted in any directions. Common regions of decreased mobility may include the scapula, cervical/thoracic spine, ribs, or pelvis.

Manual therapy, including soft tissue massage/mobilization and stretching of the surgical forelimb, nonsurgical forelimb, cervical spine, and hind limbs, may be necessary because of compensations that occur before and/or secondary to surgery. If the dog continues to have difficulty achieving full extension using ROM and mobilization techniques, a low load, long duration stretch may be performed to produce a creep of the collagen tissue, which will result in tissue elongation.¹⁵⁻¹⁸ With the dog in lateral recumbency with a towel roll placed under the brachium to act as a cushion and fulcrum, light resistance is applied to the carpus and distal antebrachium. The resistance applied should be of low magnitude to enable the dog to perform the stretch for the entire duration without pain or muscle spasm. The aggressiveness of stretching and mobilization techniques is dictated based on healing constraints of involved tissues as well as the amount of motion and end feel. If the dog has a decrease in motion and hard-end feel without pain, aggressive stretching and mobilization techniques may be used. Conversely, with a dog with pain before resistance and/or empty-end feel progress will be slower, with gentle stretching.

Cryotherapy (Fig 3) may be performed to assist in reducing pain and inflammation. The primary physiologic effects include vasoconstriction, reduced cellular metabolism and permeability, decreased motor and sensory nerve conduction velocity, analgesia, and decreased muscle spasm.¹⁹⁻²¹ Ice may be applied around the entire elbow joint for a duration of 15-20 minutes, 3-6 times daily.

Adjunctive Modalities. Several modalities may be used to aid in the healing process during this stage and



Fig 3. Phase 1 treatment. Cryotherapy of the elbow.



Fig 4. Phase 1 modality. Laser therapy of the elbow.

serve as an adjunct to manual treatments and therapeutic exercises.

Laser therapy (Fig 4) is a form of electromagnetic radiation in the near visible part of the light spectrum. Laser irradiation enhances the production of ATP within cells, and thus mediates a variety of other events, including release of growth factors, cytokine reactions and cell replication; the ultimate effect of these events is acceleration of delayed tissue healing.^{22,23} Laser treatment dosage is noted in the form of Joules (energy). A typical treatment of 4–6 J/spot is applied covering the entire treatment area. Laser therapy can be performed daily for the 1st week, then decreased to every other day during week 2. After week 2, laser may be applied on an as-needed basis.

Ultrasound therapy is a commonly used electrotherapeutic modality in human medicine, and is based upon the application of longitudinal sound waves to the body for a therapeutic effect.²⁴ Ultrasound has a direct effect on cells to stimulate healing. Treatment schedule may include daily treatment for up to 10 days, followed by less frequent sessions as the condition improves.

Transcutaneous electrical nerve stimulation (TENS) (Fig 5) is used commonly for pain relief. The primary effect of pain relief is obtained through 2 main mechanisms: the inhibition of the pain-gait theory, and via descending inhibitory mechanisms (release of endogenous opiate-like substances).²⁵ A recent study in dogs showed significant improvement in ground reaction forces (weight bearing) immediately after treatment that lasted for up to 3 hours.²⁶ Treatments initially may be applied from 3 to 7 times/week, then decreasing frequency as pain and lameness subsides.

Once the acute inflammatory phase has passed, moist heat, warm whirlpool, and ultrasound may be used at the onset of treatment to prepare the tissue for stretching and



Fig 5. Phase 1 modality. Transcutaneous electrical nerve stimulation of the elbow.

to improve the extensibility of the capsule and musculotendinous structures.

Therapeutic Exercises. The early phases of rehabilitation must also focus on retarding muscular atrophy through therapeutic exercises. Alternating rhythmic stabilization drills for thoracic limb flexion/extension/horizontal abduction/adduction and shoulder internal/external rotation are performed to begin reestablishing proprioception and neuromuscular control of the upper extremity.^{27,28} Leash walking may be initiated after surgery beginning with 5–10 minutes, 3 times/day, increasing duration to 20 minutes as tolerated by the end of acute phase. Weight-bearing exercises are initiated at this time and are performed on a daily basis. Some examples include:

Three-leg standing—lift nonsurgical forelimb and shift weight on to surgical limb (Fig 6).

Down to stand—ask dog to lie down and then to stand. Use treats as needed.

Rocking on all 4's—dog stands on all 4 limbs, gently rock the dog from side to side and diagonally, with 3 cm perturbations in each direction. Promotes weight bearing and proprioception to affected limb.

Phase 2—Intermediate Phase (Weeks 4–6)

This phase is initiated when the dog has full ROM, minimal pain and tenderness, and improved lameness. The emphasis of this phase includes enhancing elbow and



Fig 6. Therapeutic phase 1 exercise (3-leg standing) of the elbow.

upper extremity mobility, improving muscular strength and endurance, and reestablishing neuromuscular control of the elbow complex.

Stretching exercises are continued to maintain full elbow flexion and extension. Mobilization techniques can progress to more aggressive phase 3 techniques, as needed, to apply stretch to the capsular tissue and end range. Flexibility is advanced during this phase to focus on carpus flexion, extension, external and internal rotation, and horizontal adduction.

Emphasis is placed on increasing strength and proprioception to the affected limbs. Strength exercises may include longer leash walks, including up and down hills, stepping over objects such as poles/sticks, or over uneven surfaces such as sand, mulch or tall grass. Initiating walking in circles and figure 8's by starting with moderately sized circles and decreasing diameter weekly until tight circles are achieved. Figure 8 pattern may be formed around cones placed 5-6 ft apart depending on the size of the dog. Additional therapeutic exercises include:

Ladder—use an extension ladder on a level floor or cavaletti rails. Walk the dog slowly through ladder or rails to ensure individual weight bearing on all limbs.

Wheelbarrow exercises—hold both rear legs and have the dog walk on front limbs only. Begin for short distances and increase as tolerated.

Hydrotherapy—the use of underwater treadmill or swimming may be effective during this stage. Full-elbow ROM should be present and there should be no palpable tenderness/inflammation of the elbow or shoulder. Hydrotherapy sessions are performed 2-3 times/week and are started slowly, beginning at 5 minutes and increased 1-2 min/session as tolerated.

Neuromuscular control exercises are initiated in this phase to enhance the muscles' ability to control the elbow

joint during athletic activities. These exercises include proprioceptive neuromuscular facilitation exercises with rhythmic stabilizations and slow reversal manual resistance elbow/carpus flexion exercises.

Phase 3—Advanced Strengthening Phase (Weeks 7-11)

The third phase involves a progression of activities to prepare the dog for return to off-lead activity and sport participation. The goals of this phase are to gradually increase strength, power, endurance, and neuromuscular control, to prepare for a gradual return to sport. Specific criteria that must be met before entering this phase include full nonpainful ROM, no pain or tenderness, and strength and muscle mass that is 70% of the contralateral thoracic limb.

Advanced strengthening activities during this phase include aggressive strengthening exercises emphasizing high speed and eccentric contraction and plyometric activities. Elbow flexion exercises using therabands are progressed to emphasize eccentric control. Elbow flexion can be performed with therabands to emphasize slow and fast speed concentric and eccentric contractions.

Plyometric drills are an extremely beneficial form of exercise for training the upper extremity musculature.⁹ The physiologic principles of plyometric exercise use an eccentric prestretch of the muscle tissue, thereby stimulating the muscle spindle to produce a more forceful concentric contraction. Plyometric exercises are performed using jumps during the later stages of this phase to train the upper extremity musculature to develop and withstand high levels of stress. Examples of these activities include the use of a single jump exercise, then a series of jump grids, consisting of 4 jumps, first straight, then in an arc, progressing to a serpentine or threadle. Another example would be just jumping on and off a box, at several different angles.

Increasing time, distances, speed, or terrain during leash walks will aid in strengthening. Steeper hills and stairs may aid in advanced strengthening. Proprioception and stabilization exercises may be advanced with the use of wobble boards, BOSU, and/or therapeutic ball exercises (Fig 7). Placing the dog on an unstable surface such as these will further challenge the patients' proprioception as well as improve proximal strength of the forelimbs.²⁹ Progression of these exercises may include gentle rocking from side to side, and have patient follow a treat in all directions. Eccentric exercises such as walking through a tunnel, and walking backward may also be added.

Phase 4—Return-to-Activity Phase (+ 12 Weeks)

The final phase of elbow rehabilitation, the return-to-activity phase, allows the dog to return progressively



Fig 7. Phase 3 therapeutic exercise: proprioception and stabilization exercise using a therapeutic ball.

to full off-lead activity and competition using an interval return to sport program. Sport-specific functional exercises are performed to prepare the dog for the stresses involved with each particular activity or sport.

Before a dog is allowed to begin the return-to-activity phases of rehabilitation, the dog must have full ROM, no pain or tenderness, have equal thoracic limb muscle symmetry, no signs of lameness at a walk, trot or when performing tight circles at a trot, and a satisfactory clinical examination.

If healing of all tissues has occurred appropriately, advanced strengthening techniques may be encouraged such as jumping (on/off a couch or over a jump). Longer walking or trotting sessions may be necessary to build up strength and cardiovascular endurance. Gradual off-leash activities may be initiated at this time. Advancement of duration and the addition of manual balance perturbations in all directions are initiated on uneven surfaces such as the wobble boards (Fig 8), BOSU, or therapy

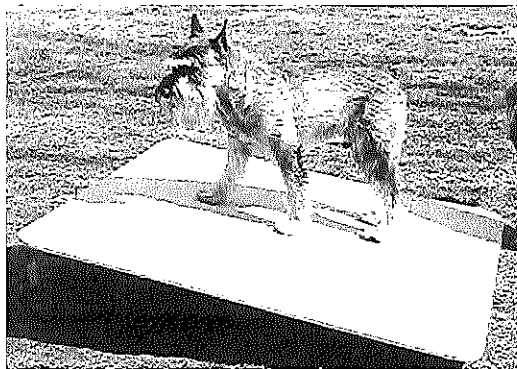


Fig 8. Phase 4 Therapeutic exercise: proprioception and stabilization exercise using a wobble board.

ball. Lifting 1 limb while performing these activities will provide further difficulty. Upon achieving the previously mentioned criteria to return to sport, a formal interval sport program is initiated.³⁰ For the performance dog, training is started 3 times/week with a day off in between each session. Each step is performed at least twice on separate days before the dog is allowed to progress to the next step. Full activity should be performed without pain or significant increase in symptoms (lameness, joint effusion, and discomfort on ROM). If the dog shows clinical signs at a particular step within the program, the owner/trainer is instructed to return to the previous step until signs subside. It is important for the performance dog to perform active stretching before training and performance. This provides an adequate warm-up, but also ensures maintenance of necessary ROM and flexibility of the thoracic limb.

Advanced strengthening and proprioception must be accomplished if return to sporting activities is a goal. Advanced training and rehabilitation may be accomplished with activities such as plyometrics sprinting, jumping, agility training, and sport-specific training. Greater balance perturbations on the BOSU (Fig 9) or therapy ball, quick directional changes/pivoting/figure of 8 exercises at submaximal effort at first, then progressing to greater speeds, cardiovascular endurance, and a continuation of strength training should be targeted.³¹

Physical therapy for orthopedic conditions has a strong scientific background in human medicine. Many studies have shown the benefits of rehabilitation after elbow injury and surgery. The canine rehabilitation therapist should be aware of and apply what is known to be effective in human practice. Many of the same goals, strategies, and techniques will be applied in the rehabilitation protocol. It should also be noted that the protocol



Fig 9. Phase 4 Therapeutic exercise: advanced strengthening and proprioception with greater balance perturbations on the BOSU.

listed above is given as a guideline to rehabilitation, regular monitoring of the exercise program and its progression is necessary for full benefit. Be aware that not all exercises work for every dog; some exercises will require trial and error to achieve desired results.

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Appendix A: Rehabilitation Therapy Flow Chart for the Canine Elbow

Phase 1—Immediate Motion Stage (Weeks 1-3)

Goals

- Improve ROM.
- Decrease pain and inflammation.
- Restore weight bearing and retard muscle atrophy.

Exercises

- Manual therapy—passive ROM, stretching, joint mobilization (Grades I and II), soft tissue mobilization/massage.

- (2) Therapeutic exercise—leash walking, rhythmic stabilization, and weight-bearing exercises.
- (3) Modalities—cryotherapy, laser therapy, ultrasound, TENS electrical stimulation, and whirlpool.

Phase 2—Intermediate Stage (Weeks 4–6)

Initiated once, full ROM, minimal pain/tenderness, and improved lameness have been obtained.

Goals

Normalize motion.
Improve muscular strength and endurance.
Establish neuromuscular control.

Exercises

- (1) Stretching joints of the entire forelimb and cervical spine.
- (2) Longer leash walks include up/down hills, stepping over objects and over uneven surfaces, circles and figure 8's, ladder/cavaletti rails, and wheelbarrow exercises.
- (3) Hydrotherapy—underwater treadmill or swimming may be started if criteria have been met.
- (4) Proprioceptive exercises begin for neuromuscular control and stabilization of the elbow joint.

Phase 3—Advanced Strengthening Stage (Weeks 7–11)

Initiated when there is full nonpainful ROM, no pain or tenderness, and strength and muscle mass that is 70% of the contralateral forelimb.

Goals

Increase strength and power and endurance.
Increase neuromuscular control.
Prepare for gradual return to sport.

Exercises

- (1) Advanced strengthening emphasizing high speed, eccentric contraction, theraband, and plyometric exercises.
- (2) Leash walks include increased time, distance, speed, and terrain. The addition of steeper hill and stairs aid in strengthening.
- (3) Advanced proprioception and stabilization exercises using wobble boards, BOSU, and therapy balls.

Phase 4—Return to Activity Stage (Week 12+)

Initiated when there is equal thoracic limb muscle symmetry, no lameness at a walk, trot, or when performing tight circles, and a satisfactory clinical examination.

Goals

Return progressively to full off-lead activity and competition.

Exercises

- (1) Gradual off-leash activities.
- (2) Longer walking/trotting sessions to increase strength and cardiovascular endurance.
- (3) Advancement of duration and perturbations of stabilization exercises.
- (4) Sprinting, jumping, and advanced plyometric training.
- (5) Sport-specific functional exercises (vary depending on activity).