

# Conservative Management of Cruciate Ligament Deficiency with Physical Therapy

Laurie Edge-Hughes, BScPT, MAnimSt(Animal Physio), CAFCI, CCRT



## Introduction

- Some animals are not surgical candidates:
  - age,
  - poor health,
  - an inadequate state of fitness
  - financial constraints, or owners' beliefs
- This subset of patients deserves a chance at optimal function as much as those that are prime surgical candidates with owners willing and able to bear the financial burden of surgery.

## Cruciate Ligament Basics

- The Cranial Cruciate Ligament in the dog:
  - Prevents translation, internal rotation and hyperextension
  - Varies in size and strength among breeds
  - Degenerates and loses strength with aging

## Damaged Cruciate Ligaments

- Resultant From:
  - A single incident if the breaking strength of the ligament is exceeded
  - Mild trauma: suggestive of daily mechanical wear, and degenerative changes as well as unsuccessful attempts at biological repair

Johnson & Johnson 1993; Vasseur 1985; Krayner et al 2008

## Damaged Cruciate Ligaments

- Incidences Within Breeds
  - Genetic basis for RCCL in Newfoundland dogs
  - High presence in Rottweilers and Staffordshire Terriers, Neapolitan Mastiff, Akita, Saint Bernard, Mastiff, Chesapeake Bay Retriever, and Labrador Retriever
  - Neutered dogs, whether male or female, have a higher prevalence of RCCL than do sexually intact dogs
  - Dogs weighing > 22kg had a higher prevalence of RCCL and at a younger age compared with dogs weighing < 22 kg.
  - Obesity has also been reported as a contributing factor

Wilke et al 2005; Whitehair et al 1993; Duval et al 1999; Johnson & Johnson 1993

## The Cruciate-Deficient Canine Stifle

- Histology
  - Increase in synovial macrophage density
  - Synovial fluid biomarkers of cartilage disease (i.e OA)
- Chronology
  - Cartilage fibrillation >> periarticular hypervascularity >> osteophyte development >> medial joint swelling >> periarticular fibrosis (restabilization) >> meniscal injury >> peak osteophyte formation & synovitis >> settling of synovitis >> articular erosion, collagen fibril network break-down >> >> slowing of osteophyte formation

Innes et al 1999; Johnson et al 2002; Klocke et al 2005; Sprend et al 2000

## The Cruciate-Deficient Canine Stifle

- Gait Analysis of RCCL dogs
  - Increase in stifle flexion (in stance & early swing)
  - Failure to fully extend in late stance
  - Hip and tarsus are more extended in stance
  - Overall loss of propulsion
  - (NOTE: In this study, meniscal injuries occurred in several dogs by 3-months)
  - (NOTE: Joint fibrosis is insufficient in 6 months to result in joint stability and gait improvement)

DeCamp et al 1996

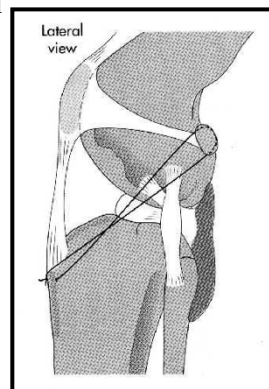
## The Cruciate-Deficient Canine Stifle

- Surgical Reconstruction
  - Following RCCL reconstruction (at 7 & 13 months):
    - An increase in the global progression of OA disease
    - Proliferation of osteophytes
    - Joint effusion
    - Quadriceps atrophy
  - Following unilateral RCCL reconstruction:
    - Contralateral stifle joint OA

Innes & Barr 1998; Innes et al 2004; de Bruin et al 2007

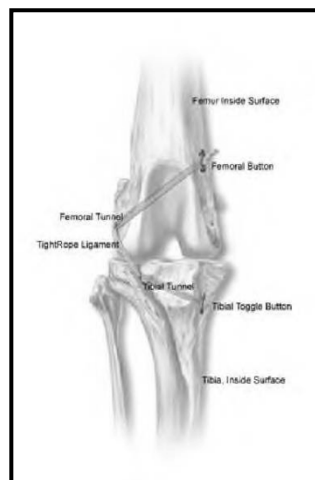
## The Cruciate-Deficient Canine Stifle

- Cranial Cruciate Ligament Repair
  - Extracapsular repair
    - Complications: filament failure, meniscal tears, infection, nerve palsy



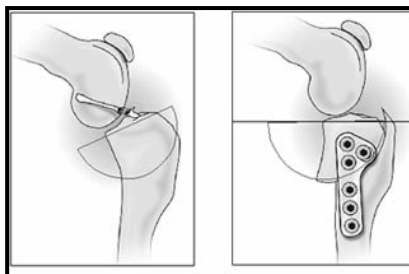
## The Cruciate-Deficient Canine Stifle

- Cranial Cruciate Ligament Repair
  - Tight Rope Technique
    - Complications: filament failure, joint loosening, meniscal tears, infection



## The Cruciate-Deficient Canine Stifle

- Cranial Cruciate Ligament Repair
  - Tibial Plateau Levelling Osteotomy
    - Complications: Implant failure, meniscal tears, patellar tendon desmitis, tibial tubercle avulsion, infection



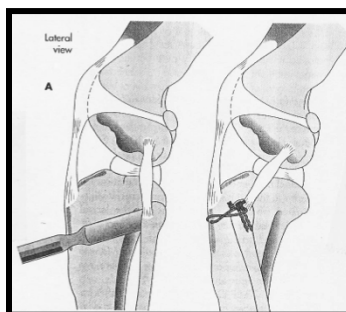
## The Cruciate-Deficient Canine Stifle

- Cranial Cruciate Ligament Repair
  - Tibial Tubercle Advancement
    - Complications: Implant failure, meniscal tears, patellar tendon desmitis, tibial tubercle avulsion, infection



## The Cruciate-Deficient Canine Stifle

- Cranial Cruciate Ligament Repair
  - Fibular Head Transposition
    - Complications: Screw breakage or backing out, meniscal tears, fracture of fibula, infection



## The Cruciate-Deficient Canine Stifle

- If we were to spend hours reading through the 1124 scientific papers on the canine knee to determine if there is a best surgical method:
  - “An evidence-based medicine paradigm did not provide sufficient evidence favoring 1 surgical technique for management of canine CCL injury.”

Aragon et al 2005

## The Cruciate-Deficient Canine Stifle

- Very little research exists dedicated to conservative rehabilitation of CCL-deficiency.
  - Vasseur 1979
- Some studies use CCL-deficient dogs as controls...but EVIDENCE-BASED rehabilitation programs are not part of standard management in these studies.

## The Cruciate-Deficient Human Knee

- Comparisons have been made between surgical and conservative management of cruciate-deficiency
- Ciccotti et al 1994 concluded that:
  - Rehabilitation does not restore normal EMG patterns, yet surgery does.
    - Vastus lateralis, rectus femoris, biceps femoris, tibialis anterior
  - There is likely a reduction in performance in ACL-D knees in more strenuous sports.
  - Neuropathways other than those mediated by ACL mechanoreceptors must exist to coordinate muscle activity.



## The Cruciate-Deficient Human Knee

- Problems with symptomatic human ACL-D Knees
  - Greater flexion angles during stance phases
  - Quadriceps weakness (persistent in poorly functioning knees)
  - Symptomatic ACL-D knees exhibit more anterior displacement than non-symptomatic ACL-D knees with weight bearing
    - NOTE: static translation does not correlate with function
  - Significant proprioceptive deficits in symptomatic ACL-D knees
    - NOTE: relation between poor proprioception and chondral or meniscal lesion

Wexler 1998; Tagesson et al 2008; Friden et al 1993, 1999, 2001; Roberts et al 1999, 2000; Zatterstrom et al 1994

## Rehab of the ACL-D Human Knee

- Successful treatment of non-surgical ACL-deficient knees has been shown to be possible with specifically targeted rehab programs.
- Noyes et al 1983 proposed the rule of thirds for chronic ACL-D treated with rehab:
  - 1/3 manage w/o reconstruction
    - And resume previous recreation activities
  - 1/3 manage w/o reconstruction
    - By modifying or lowering their activity level
  - 1/3 require reconstruction
    - Due to recurring 'giving-way' episodes
- Thus we have copers, compensators & non-copers



## Rehab of the ACL-D Human Knee

- Comparison of Function of the ACL-D rehabbed knee and normal knees:
  - Single leg hop test was normal:
    - In 77% of subjects at 1-year post-injury
    - In 89% of subjects at 3-years post-injury
    - In 85% of subjects at 15-year post-injury
  - Strength (isometric and concentric) was normal:
    - In 42 – 56 % of subjects at 1-year post-injury
    - In 54 – 68% of subjects at 3-years post-injury
    - In 69 – 82% of subjects at 15-years post-injury



Ageberg et al 2001 & 2007

## Rehab of the ACL-D Human Knee

- Comparison of Function of the ACL-D rehabbed knee and normal knees:

**Table 2. Tegner activity level scoring following unilateral ACL injury (median)**

Treatment	Pre-injury	1-Year Follow-up	3-Years Follow-up	15-Years Follow-up
Rehabilitation only	7	6	6	4
Reconstruction & Rehab	7	5	6	5

Kostogiannis et al 2007

## Rehab of the ACL-D Human Knee

- Comparison of Function of the ACL-D rehabbed knee and normal knees:
  - Subjective knee function / Quality of Life scoring
    - Highest scores at 1 & 3 years post-injury in rehab only groups
      - Those injured in contact sports scored the lowest
    - At 15-years post-injury:
      - Reconstruction group scored lower than non-reconstructed



Kostogiannis et al 2007

## Rehab of the ACL-D Human Knee

- Comparison of Function of the ACL-D rehabbed knee and normal knees:
  - Radiographic evidence of osteoarthritis at 15-year mark
    - 16% of rehab-patients developed OA
      - ALL of these patients had undergone a meniscectomy!
      - NONE of the non-meniscectomized patients developed OA!
  - Subjective report of symptoms
    - 68% reported to be asymptomatic at 15-years post-injury
    - 23% had had reconstruction at an average of 4-years after-injury



Neuman et al 2008

## Rehab of the ACL-D Human Knee

- Comparison of Function of the ACL-D rehabbed knee and normal knees:
  - Myklebust et al 2003 found:
    - 91% of competitive handball players without ACL – reconstruction , could return to pre-injury activity level
    - 58% of reconstructed group could do the same
  - Casteleyn 1999 in a literature review found:
    - ACL-reconstruction = least amount of secondary meniscal surgeries
    - ACL-reconstruction = greater osteoarthritic morbidity
    - ACL-reconstruction = higher sports participation



## Conservative Rehab of Canine Cruciate-Deficiency

- GOALS in successful management of ACL-D in humans:
  - Early activity modification
  - Neuromuscular knee rehabilitation
  - Strength training
- STAGING the goals through rehab:
  - TIME does not dictate progression
  - Attention should be paid to ROM, strength, fluidity of performance of functional activities, & functional testing



Ageberg et al 2007; Kostogiannis et al 2007; Markey 1991; Neuman et al 2008; Tagesson et al 2008; Brozman & Wilk 2007

## Conservative Rehab of Canine Cruciate-Deficiency

**Table 3. Goals and Treatment Suggestions for Phase 1 (Protection) of the Canine ACL-D Stifle**  
**Phase 1: Protection (Weeks 1 – 4)**

Increase ROM	PROM flexion and extension; tummy rubs into extension; 'square' sitting practice.
Increase muscle function using movement synergies and utilizing motor learning transfer	Active sitting down to a stool (guiding rear legs for symmetry of movement); Toe pinches (alternating and simultaneous) in side lying; leash walking to toilet, progressing to 5 minutes and increasing time by 3 – 5 minutes per week (if no increase in joint inflammation); Weight shifting exercises; Balance board exercises (front legs on the board); Standing on soft surfaces and balance; 3-leg standing; step ups; Walking in circles or figure-of-8 patterns.
Increase proprioception	Joint compressions; Grades 1 – 2 joint mobilizations.
Decrease pain and effusion	Icing; PROM & AROM within pain tolerance; joint compressions; Grades 1 -2 joint mobilizations; NMES; Modalities.

## Conservative Rehab of Canine Cruciate-Deficiency

**Table 4. Goals and Treatment Suggestions for Phase 2 (Early Strengthening) of the Canine ACL-D Stifle**

**Phase 2: Early Strength Training (Weeks 5 – 8)**

Full ROM	As above; may add toe-touch hanging, or extension on the stairs; may add sitting practice on a stool or platform.
Normal gait	Walking with a 'disturbance' on the unaffected foot; Obstacle walking or trotting; Steep up-hill walking or trotting;
Increase motor control (neuromuscular training) and strength	Underwater treadmill or swimming exercise; NMES or manual tapping on quadriceps or gluteals with 3-leg standing; NMES or manual facilitation on/ of hamstrings with sitting practice; Side stepping or back stepping over a pole; Stepping up backwards; Walking backwards; Any of the above land exercises on a soft surface; Hill walking; Stair walking.
Load: 50 – 60% of uninjured limb	Increase time and duration of exercises above.

## Conservative Rehab of Canine Cruciate-Deficiency

**Table 5. Goals and Treatment Suggestions for Phase 3 (Intense Strengthening) of the Canine ACL-D Stifle**

**Phase 3: Intense Strength Training (Weeks 9 – 12)**

Increased strength, and motor control (neuromuscular training)	Continue most challenging exercises from above; Walking with a weight on the affected leg (open kinetic chain training); Trotting up-/down-hills; Walking on uneven surfaces; Recall running between two people.
Increase Load: 70 – 80% of uninjured limb (increasing by 10% nearer end of stage)	Increase time and duration of exercises above; Perform exercises above with a weight pack.

## Conservative Rehab of Canine Cruciate-Deficiency

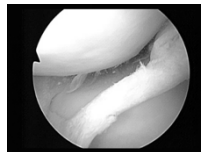
**Table 6. Goals and Treatment Suggestions for Phase 4 (Intensive strength training and return to sports) of the Canine ACL-D Stifle**

**Phase 4: Intensive Strength Training and Return to Sports (13 – 16 weeks)**

Increased strength	Continue most challenging exercises from above; Destination jumping exercises from a stand (plyometrics).
Increased coordination	Agility-type training.
Increased ability in sport-specific activities	Short-distance ball retrieves; 1 or 2 agility-type pieces of equipment; Avoid play with other dogs until closer to 6 months or longer and start with only short intervals.
Load 80% of uninjured leg (increasing by 10% nearer end of stage)	Increase time and duration of exercises above; Perform exercises above with a weight pack.

## Conservative Rehab of Canine Cruciate-Deficiency

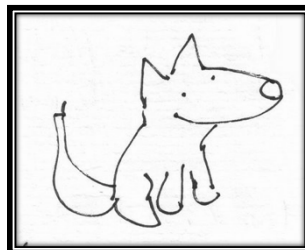
- Cautions
  - Meniscal injury may inhibit success of this regimen
  
- Secondary Goal
  - Prevent Osteoarthritis
    - Advisement on supplementation: glucosamine and fatty acids
    - Weight loss or weight maintenance advice



Bruyere et al 2003; Canapp et al 1999; Curtis et al 2002; Hesslink et al 2002; Impellizeri et al 2000; Johnson et al 2001; Messier et al 2005; Richardson et al 1997; Verbruggen et al 2002

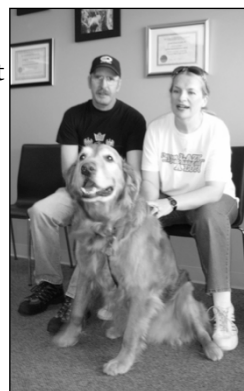
## Conclusion

- Conservative rehabilitation of the cruciate ligament deficiency can yield GOOD functional recovery.
  
- Great option for older animals
- Better for those not engaged in high energy sporting activities
- Good for non-surgical candidates



## CASE EXAMPLE - KAIN

- ID: 6 year-old, neutered male, Golden Retriever
- Hx:
  - Left stifle partial ACL tear Feb 20, 2008
  - Full tear left ACL April 10, 2008
  - Owners adamant about conservative management
- Regimen prior to rehabilitation consult:
  - Supplements: (enough to make your head spin!)
  - Deramax
  - Leg lifting exercises (one at a time x 4 legs)
  - 2-leg standing with feet on sofa / bed
  - Obstacle course over owner's legs
  - Sits / Squats
  - No walks



## CASE EXAMPLE - KAIN

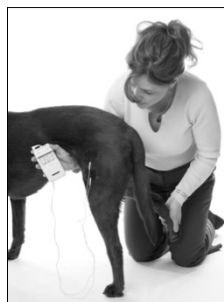
- Rehab Assessment Findings: April 29<sup>th</sup>, 2008
  - Medial buttress & Stiff into end-range flexion & extension
  - cranial drawer in both flexion and extension
  - Proximal thigh circumference: 45cm RH & 42.5cm LH
  - Partial weight bearing in stance and walking
- Rehab Program:
  - Underwater Treadmill 2x/wk + laser therapy to joint line
  - Extensive Home Program





## CASE EXAMPLE - KAIN

- Rehab Progression:
  - UWT Bi-weekly,
  - alternating with therapist-supervised exercise program directed at strengthening & proprioception, and
  - advancement of home program



## Case Example - KAIN

- Evaluation – July 26, 2008
  - Cranial drawer only detectable in Flexion
  - Proximal Thigh Circumference 43.5cm LH & 46cm RH
  - No lameness at a walk, no off-loading of leg in stance
  - Doing long walks on flexi-leash + hills 30 + minutes 2x/day
  - Using LH leg to stand on when urinating ☺
  - Scratches himself using LH leg
  - Stiffness when first gets up for 1 – 2 steps



## Case Example - KAIN



## Case Example - KAIN



- Discharge Evaluation – Oct 25, 2008
  - Tolerating 5 mile walks (off leash)
  - Stiff in back end when first gets up (same as before injury)
  - Weight bearing measurements:
    - 19% on Left Hind & 19.5% on Right Hind (Normal being approximately 20% each)
  - Proximal thigh circumference 42cm bilaterally!
  - ROM: full flexion, extension near full (lacking last 5°)
  - No detectable drawer in flexion or extension

Thank you to Pure Care for providing equipment used in this case

## Case Example: Riley

- ID: 3 year old, Spayed female, Shepherd X
- Hx:
  - Arrived at Humane Society with a “chronic” cruciate injury in February 2007
  - Extracapsular repair performed & fostered by technicians (now owner)
  - Surgical failure at 2 – 4 weeks post-op
  - Second surgery not advised:
    - No noticeable lameness, unless after exercise or after resting
    - Behavioural issues
    - Insistent of being airborne and running!
    - Likes to climb trees



## Case Example: Riley

- Conservative Management undertaken by owner:
  - Kennelled x 4 weeks & Toileting 4x/day for 4 weeks
  - At 4 weeks: leash walking starting at 5 mins/day and building 5 minutes per week.
  - AT 14 – 16 wks post-op, walks were up to 1 hour/day & at 5 – 6 months post-op walks were often 2 hours/day
  - Began running 1 – 3 miles/day at 5 – 6 months
  - Supplements now: Dasuquin

## Case Example: Riley

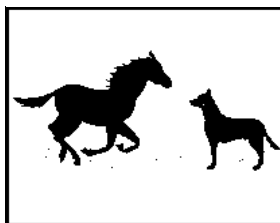
- Review of Riley in June 2008
  - Subjective: Rarely lame. If she runs/plays crazy with another dog, for 20+ minutes, she can become sore. Rimadyl is used in those cases.
  - Objective Findings:
    - 1.5cm difference in proximal thigh circumference between legs
    - Medial buttress
    - Cranial drawer in flexion only (tibia had to be repositioned caudally to get the drawer). NO drawer in extension
    - Full ROM, no lameness / gait abnormalities
    - No pain on meniscal testing (McMurray and Cyriax Quadrant)
    - Mild palpable atrophy of gluteal muscles
    - Trendelenburg sign which remedied with stimulation of quads

## Conservative Rehab of Canine Cruciate-Deficiency

- *It CAN be done!*
- *Thanks for listening!*



The Animal Rehab Division



Of the

The Canadian Physiotherapy Association

