Introduction to Animal Rehabilitation

Day 2: Canine Neuro-rehab

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Our Focus

- The Canine Nervous System
- The Objective Physical Therapy Neuro-rehabilitation Evaluation
- Progression of Physical Therapy Neuro-rehabilitation Interventions

The Canine Nervous System

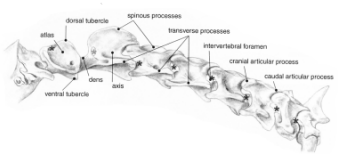
Don't Be Nervous!

- Every patient, whether human or animal, has:
  - Joints
  - Muscles
  - Ligaments & Tendons
  - Nerves

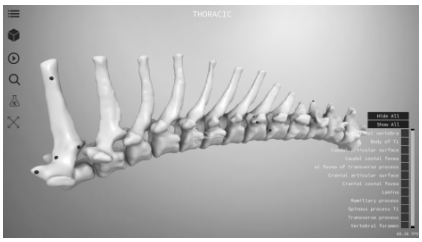
Review of Neuro-Anatomy

- Canine Vertebral Formula
  - C7 T13 L7 S3 Cd20
- Feline Vertebral Formula
  - C7 T13 L7 S3 Cd5-23

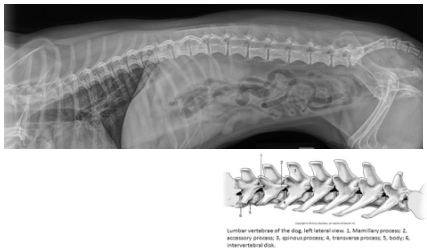
Cervical Vertebrae



Thoracic Vertebrae

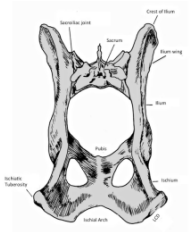


Lumbar Vertebrae

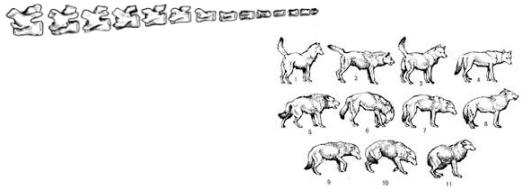


Lumbar vertebrae of the dog, left lateral view. 1, Mamillary process; 2, accessory process; 3, spinous process; 4, transverse process; 5, body; 6, intervertebral disk.

Sacral Vertebrae & the Sacroiliac Joint



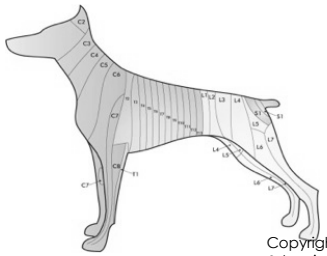
Coccygeal Vertebrae



Canine Neuro-anatomy Pearls

- Spinal cord segment position relative to vertebral position
  - **Thoracic** spinal cord segments lie 1 vertebra cranial to the vertebra of the same number
  - **Caudal thoracic & cranial lumbar** segments lie at a position corresponding to the vertebra of the same number
  - **Caudal lumbar, sacral, & coccygeal** segments are cranial to corresponding vertebrae
- The T11 vertebra is anticlinal
- The spinal cord ends at L5-L6-L7
- Vertebral articular planes are dorsal oblique cranial to T11 & sagittal caudal to T11
  - This allows for tail wagging

Dermatomes



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Neural Innervation of the Forelimb

- Brachial plexus (C6-T2)
- Brachiocephalic (C7, C8) brachiocephalicus
- Subscapular (C6, C7) subscapularis
- Suprascapular (C5, C6, C7) supraspinatus, infraspinatus (possible damage with scapular neck fracture)
- Cranial pectoral (C6, C7, C8) superficial pectoral
- Caudal pectoral (C8, T1, T2) deep pectoral
- Long thoracic (C7) serratus ventralis
- Musculocutaneous (C6, C7, C8) biceps, brachialis, coracobrachialis
- Axillary (C6, C7, C8) deltoid, teres major/ minor, subscapularis
- Thoracodorsal (C7, C8, T1) latissimus dorsi
- Lateral thoracic (C8, T1) cutaneus trunci, deep pectoral
- Radial (C7, C8, T1, T2) triceps, ext carp rad, ulnaris, lat, common dig ext, lat dig ext, supinator, abd pollicis longus (paw flip if injured)
- Median (C8, T1, T2) flex carp rad, sup dig flex, deep dig flex, pronator teres, pronator quadratus (digging)
- Ulnar (C8, T1, T2) flex carp uln, deep dig flex, interosseus (spreading digits in weight bearing if injured)

Neural Innervation of the Hind Limb

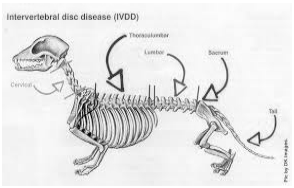
- Lumbosacral plexus (L3-S3)
- Lat. Cut. Femoral (L3, L4, L5) psoas
- Femoral (L4, L5, L6) iliopsoas, quad, sartorius (injured in ventral luxation)
- Saphenous (L4, L5, L6) sartorius
- Obturator (L4, L5, L6) ext obturator, pectineus, gracilis, adductor (splits if injured)
- Cranial gluteal (L6, L7, S1) middle glut, deep glut, tensor fascia lata
- Caudal gluteal (L7, SI, S2) sup glut, middle glut
- Sciatic (L6, L7, S1, S2) int obturator, gemelli, quadratus femoris, biceps femoris, semimembranosus, semitendinosus, abductors (injured in SI luxation, fracture, trauma)
- Common peroneal (L5, L6, L7) peroneus longus, lat dig ext, long dig ext (injured in CCL surgery, knuckling)
- Superficial peroneal (L5, L6, L7) peroneus brevis, lat dig ext
- Deep peroneal (L5, L6, L7) cranial tibial, long dig ext, peroneus longus
- Tibial (L5, L6, L7) gastroc, popliteus, sup dig flex, deep dig flex
- Pudendal (S1, S2, S3) caudal rectal, external anal

What if a Dog with… "Walks" in the Door?

- Intervertebral disk disease (IVDD)
- Spondylosis
- Stenosis
- Fibrocartilagenous embolism (FCE)
- Atlanto-axial (AA) instability/luxation
- Wobbler syndrome
- Peripheral nerve injury
  - Trauma
  - Surgery
- Limber tail or cold tail
- Degenerative myelopathy (DM)

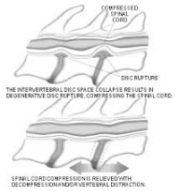
Hansen Type I vs. II Disk

- Hansen Type I
  - Annulus rupture
  - Extrusion of disk material into spinal canal
  - Common in small or chondrodystrophic dog breeds
- Hansen Type II
  - Annulus thickening
  - Pressure/compression of spinal cord
  - Common in larger breeds



Wobbler Syndrome

- Wobbler's, cervical vertebral instability/malformation (CVI/CVM), or cervical spondylomyelopathy
- Head low, ataxia (hypermetria), wide base of support vs. scissoring, knuckling, etc.
- Spinal cord compression due to malformation/narrowing of canal or disk herniation



Degenerative Myelopathy

- Similar to amyotrophic lateral sclerosis (ALS)
- Progressive distal to proximal motor weakness & incoordination
- Hereditary
  - Gene mutation SOD1
  - Orthopedic Foundation for Animals (OFA) saliva test
- German Shepherd Dog, Pembroke Welsh Corgi, Chesapeake Bay Retriever, Boxer

Am I Missing Anything???

The Objective Physical Therapy Neuro-rehab Eval

Essential Components of the Evaluation

- Our focus?
  - Function & motor control
- Subjective
  - History
  - Social history
  - Mentation & motivation
  - Bowel & bladder
  - Return to work/life/play
- Objective
  - Functional mobility & gait
  - Motor control
  - Sensory awareness
- Assessment
  - Goals
- Plan

Subjective

- History
- Social history
- Mentation & motivation
- Bowel & bladder function
- Return to work/life/play

History

- History of past & present insult/injury (PMH/HPI)
  - Veterinary record
  - Client report
- Medications
- Procedures
- Imaging/test results
- Other interventions
  - Acupuncture
  - Chiropractic
  - Massage therapy
  - Reiki

Social History

- Home environment
  - Surfaces (indoors/outdoors)
  - Stairs (number/type/surface)
  - Ramps
  - Doggie doors (height from floor inside/outside, size, weight of door)
  - On/off furniture
- Sleeping environment
  - Sleeps in kennel, on dog bed, with "mom" & "dad"…
- Other pets & family members

Social History

- Equipment or assistive devices
- Normal day/activity
  - A day in the life…
- Social
  - Doggie day care, "friends"
- Car travel
  - Type of car
  - Where in car?
  - Method of restraint
  - Method of entry/exit (ramp, lift, steps)

Mentation, Motivation, & Motor Control

- Mentation
  - Cognition, communication, arousal, perception
- Motivation
  - The "Go Getter" Personality (Type A)
    - Motivated, frustrated, assertive or aggressive
    - Responds to motivational cues
    - Manual, verbal, visual, toys, treats, etc.
  - The "Eeyore" Personality (Type B)
    - Difficult to motivate, depressed affect, "lazy"
    - Passive to motivational cues

Bowel & Bladder Function

- In's & out's
- Frequency of urination/defecation
- Accidents
- Indicates a need to "go"?
- Need to be expressed?
- Postures
  - Squat, lean, lift, collapse, or travel?
- Infections (past or present)?

Return to Work, Life, & Play

- What are the clients' goals?
- Are they realistic?
- How long will it take?

"What about You?"

- Client health status
  - Mental
  - Physical
- Body mechanics training
- Counseling & assistance
  - Hospice/home care organizations
  - rDVM
  - Rescue organizations

Objective

- Functional mobility, transitions, & gait
- Motor control
- Sensory awareness

Functional Mobility, Transitions, & Gait

- Compensation
- Adaptation
- "Cheating"
- Consider environment, abilities, conformation, habit/training, etc.

Objective Observational Evaluation

- Hands off evaluation/observation
- Functional mobility
  - Assume a posture/position (recumbent, sit, stand)
  - Maintain a posture/position
    - Static
  - Transition to/from a posture/position
    - Dynamic
- Activities of Daily Living (ADL)
  - Functional & meaningful

Functional Mobility

	Recumbent	Sit	Stand	Postures of Elimination	Postures for Eating & Drinking
Assume					
Maintain					
Transition					
Static Balance					
Dynamic Balance					

-Can patient A/M/T independently or with assistance?
-How much assistance (max, mod, min)?
-Balance grade (good, fair, poor)?

Observational Inferences

- AROM
- Strength
- Endurance
- Balance
- Coordination
- Sensory awareness/integration
  - Proprioception
  - Kinesthesia

Motor Control

- Quality vs. quantity of movement
- Balance & coordination
- Eccentric & concentric muscle contractions

Sensory Awareness & Integration

- Senses provided:
  - Internally (from sensory receptors)
  - Externally (from the environment, handling)
- Sensation will affect movement
  - Feedback for grading of muscle contractions & motor control
  - "Feedforward"
- FOR EVERY PATIENT…
  - CHECK CONSCIOUS PROPRIOCEPTION!

How it's Done: The PT Consult

- Subjective interview concurrent with the observational analysis
- Hands-on examination & evaluation
  - Orthopaedic
  - Cardiovascular
  - Integumentary
  - Neurological
- Treatment & facilitation
- Assistive device trial
- Home program instruction
- Discussion of the PT plan

Orthopaedic Considerations

- ROM vs. flexibility
- Consider potential treatment contraindications, precautions, & red flags with regards to…
  - Hypermobility/instability
    - MPL/LPL
    - MSI
      - Impingement or history of shoulder tendinopathy
    - CVI/CVM/Wobbers
    - Accessory motion testing
- OA/DJD
  - Spondylosis
- Lumbarization/sacralization
- Facet impingement

Cardiovascular Considerations

- Weight
- Body condition score (BCS)
- Vitals
- Cardiovascular endurance/fitness
- Consider pre-morbid activity level, length of hospitalization, length of restricted activity, time from injury until initiation of rehab
- Caution/attention to level of injury & innervation of secondary respiratory muscles

Integumentary Considerations

- Nails
  - Worn tops, worn tips, evidence of injury to quick, split nails
- Skin
  - Surgical incision
  - Abrasions
    - From dragging
  - Decubiti/pressure sores
    - From stationery position, not turning
- Coat
  - Soft or coarse? Dry?
  - Areas of clipped fur
    - Is the pet licking this area? Is it irritated & red?
- Overall condition
  - Look, feel, smell

Neurological Considerations

- Functional strength
- Coordination/grading of muscle contractions
- Balance
- Sensory awareness/integration
- Reflexes & postural reactions
- Tone, spasticity, & spasm
- Neural/dural tension

Functional Strength

- Inferences based on functional mobility evaluation
- Respecting "kinetic chain"
- Not motor control or grading of muscle contractions (concentric, eccentric, isometric)
- Consider mobilizers (large, span multiple joints, fast twitch) vs. stabilizers (small, span one joint, slow twitch)
- Grade flexors vs. extensors, of forelimb vs. hind limb, using Manual Muscle Test (MMT) "grades" 0/5, 1/5, 2/5, or 3/5

Treatment Planning

- Neuro-rehab evaluation
  - Long term goals (LTG)
    - Ideal
    - Realistic outcome
  - Short term goals (STG)
    - Show progress
    - "Baby steps"
  - Strategies
  - Tactics
  - Referrals

Goals

- Improve muscular contractile forces
- Increase functional mobility
- Initiate the relearning of movement patterns
- Improve the ability to react to multidirectional forces
- Increase muscle activation
- Improve stance control
- Change reflexive movement into volitional/active mobility
- Alter patient response & quality of movement through reflexes/postural reaction facilitation

Treatment Planning & Progression

- Pre-test
- Plan the intervention
  - Activity
  - Patient position
  - Equipment
  - Environment
  - Techniques
- Implement the intervention
- Post-test

Compromises

- Team approach
- Complimentary goals
- Collaborate
- Multiple options
- Respect the "individual"
- Know the motivation/motivator

Reality

- The patient is not "ideal"
- Funds are limited
- Time is limited
- Referrals are late. I'm the last resort.
- Neuro-rehab is a negotiation
- Research is lacking or non-existent

Challenges

- It's "us" vs. "time"
- How will we prove that rehab is necessary & effective?
- "Art" based on "science"
- Challenging prognosis
- Potential for no diagnosis
- Art of setting goals. How do we "sell" rehab?

Progression of Physical Therapy Neuro-rehabilitation Interventions

Phases of Neuro-rehabilitation

- Early mobilization
- Integration of reflexive movements
- Tone modulation
- Motor learning for re-integration of the neuromuscular system & recovery of function

Phase 1: Early Mobilization

Early Mobilization: Patient Presentation

- Flaccid/hypotonic
- Reflexive responses
- With/without patient acknowledgment
- Deep pain negative or absent cutaneous sensation
- Polysynaptic reflexes present

Early Mobilization: Treatment Tactics

- Get upright
- Get outside (or home)
- Find the motivation
- Stimulate neuro-pathways with sensory input
- Supportive positioning for vestibular & visual stimulation
- Sensory stimulation for withdrawal crossed extensor, extensor thrust, & protective extension response/reflex
- Use PNF stretch, elongation/windup, irradiation, approximation, & traction

Early Mobilization: Home Program Options

- Toe, pad, or webspace pinches or tickles in varied limb positions (lateral recumbency, supported standing)
- Sensory stimulation
- Approximations
  - In supported standing
  - In NWB, at individual joints or the entire limb
- Supported standing
- Supported walking

Phase 2:
Integration of Reflexive Movements

What is a Reflex?

- A sterotyped response to a specific sensory stimulus
- Locus of stimulus determines which muscles contract
- Strength of stimulus determines amplitude of contraction/response
  - Spatial & temporal summation

Reflexes & Reactions

- Scratch reflex
- Primitive reflexes
  - Symmetric tonic neck
  - Asymmetric tonic neck
  - Symmetric tonic labyrinthine
- Positive supporting reactions
  - Dancing
  - Wheelbarrowing
  - Hemiwalking
  - Hopping
- Righting Reactions
  - Neck righting on body
  - Body righting on body
  - Labyrinthine head righting
  - Optical righting
  - Body righting on head
  - Equilibrium reactions

Movement Patterns & Synergies

- Synergistic, coupled, predictable, stereotypical, cooperative action of muscles
  - Whole limb movement incorporating entire limb & trunk
  - Diagonal movement patterns (PNF)
  - Influenced by distal component/key point of control (NDT)
  - Normal or abnormal
  - Desired or detrimental
- Recruitment
  - Governed by primitive reflexes
  - Related to muscle action & innervation
- Timing & coordination
- Recovery follows a predictable pattern
  - Bobath, Brunnstrom
- Normal synergies
  - Swing
  - Stance
  - Postures of elimination
  - Scratching
  - Jumping
- Abnormal synergies
  - Exacerbated by stress, fatigue, injury/illness
  - Scissoring hind limb gait
  - Hip IR with "grooming"

Reflexes & Postural Reactions

- Why?
  - Localize lesion
  - Direct goals
  - Influence treatment
  - Explain observations
- Note not just presence/absence but also the "problem"
  - Strength
  - Sensory awareness
  - ROM/flexibility
  - Quality of postures & movements

Reflexes in Rehab

- Test reflexes
- Observe patient in varied positions/transitions
  - What is the desired response? Observed response?
- Can we manipulate & utilize reflexes to address your therapeutic goals?
- Treatment or position based on observations & goals
  - Individual limbs, multiple limbs, head/neck, or trunk?
  - Extension or flexion?
- Reflexes or reactions
  - Present or absent?
  - Normal or abnormal?
- Can responses help us to meet goals?
- How can we promote transition from reflexive movement to volitional mobility?

Reflexive Movement: Patient Presentation

- Trace (1/5) to fair (3/5) muscle contractions, especially proximally
- Muscle tone fluctuations
  - Body position
  - Arousal
- Maintain sit or stand independent
  - Poor balance
- Assist with transitions
- "Doesn't like" toe pinches
- Paresthesias?

Reflexive Movement: Treatment Tactics

- PNF massed flexion & rhythmic stabilization
- PNF irradiation, appropriate resistance, approximation, & traction

Reflexive Movement: Home Program Options

- Cookie stretches
  - Sitting or standing
- Transitions
  - Lateral to sternal
  - Lateral to sit
  - Lateral to stand
- Assisted walking

PNF Philosophy of Treatment

- Positive approach to treatment;
- Patterns of movement, have a specific, purposeful, & functional goal;
- Stronger components of this functional movement or of the extremities to strengthen the weaker through irradiation & overflow;
- The therapist attempts to tap the maximal response of the patient to effectively increase motor & sensory awareness. Repetition of this maximal response promotes motor learning;
- Intensive program with continuous activity. "Active rest" is an integral part of PNF treatment;
- The overall goal/result is optimal function with an integrated neuromuscular system.

PNF

- Concept
- "All (human) beings, including those with disabilities, have untapped existing potential."
  - Kabat, 1950
- Principles
- Integrated/whole-istic approach
- Positive approach
- Reinforcing abilities
- Goal of helping patients achieve highest level of function/potential

PNF

- Specific, purposeful, functional movements
- Stronger components strengthen weaker
- Irradiation
- Overflow
- Exploit maximal response for improved sensory-motor awareness
- Repetition for motor learning

PNF Massed Flexion

PNF Rhythmic Stabilization

Phase 3: Tone Modulation

Tone Modulation

- Reflexes
- PNF
- NDT
- Rood Sensorimotor Technique

Muscle Tone

- Hypertonicity inhibiting independent function
- Hypotonicity leaving patient with poor prognosis
- Can't alter presence/absence of deep pain
- Hypertonicity affects the "quality" of movement of the patient
  - At risk for skin breakdown

Resistance

- Increase/improve muscle tone
- If applied to hypotonic/flaccid area…
  - Potential for normalizing tone
- If applied to area with normal tone…
  - Potential for hypertonicity
- "Right place, right time."

Tone Modulation: Patient Presentation

- Compensation for lack of motor control
- Muscle imbalances
- Spinal walking
- Altered cutaneous sensation
- Polysynaptic reflexes inhibited

Tone Modulation: Treatment Tactics

- Postural reflexes to influence tone
- Rood Sensorimotor Technique
- PNF procedures

Tone Modulation: Home Program Options

- "Targeted" sensory stimulation
- "Augmented" functional mobility activities
- Focus on quality of movement

Rood Sensorimotor Technique

- Facilitation
  - Quick ice
  - Compression
  - Tapping
  - Brushing
  - Vibration
  - Quick stretch
- Inhibition
  - Light joint compression
  - Slow rhythmic movements
  - Rhythmic rotation
  - Prolonged icing
  - Deep tendon pressure

PNF Procedures

- Optimal resistance
- Irradiation & reinforcement
- Manual contact
- Body position & mechanics
- Verbal command
- Vision
- Traction & approximation
- Stretch
- Timing
- Pattern

Optimal Resistance

- "Optimal" = assistance OR resistance
- Goal-oriented
- Avoiding abnormal synergies
- Non-painful
  - Pain is inhibitory!
- Type
  - Isotonic
    - Concentric
    - Eccentric
  - Stabilizing isotonic
  - Isometric

Irradiation & Reinforcement

- Irradiation
  - Spread of response (+ or -) in specific & predictable patterns
- Reinforcement
  - Influence of resistance of strong muscle groups on weak muscle groups
  - Utilized in timing for emphasis

Manual Contact

- Multiple contacts vs. single
- What is your desired response?
- Pressure…
  - On **muscle** aids ability to contract
  - In direction opposite to desired direction of motion
  - On **trunk** promotes trunk stabilization (indirect treatment of limb)
- Lumbrical grip
- For example… MMT biceps with manual contact on biceps vs. triceps

Body Position & Mechanics

- Therapist focused & in the line of movement
  - Eyes, face, shoulders, pelvis, toes
- Therapist is active
  - Resistance is from therapist's body, not hands/arms
  - Hands relaxed
    - What is being communicated to the patient?
  - Neutral wrist & spine
- Not optimal or expected result?
  - Move patient first
  - Then move yourself
- For example… MMT knee extension from front vs. side

Verbal Command

- Timing with contraction effort for coordination
- Strength & effort influenced by
  - Volume
  - Tone
- For example… arm wrestling

Vision

- Movement of eyes affect head & body motion
- For communication
- For example… Feldenkrais trunk rotation

Traction & Approximation

- Response varies per patient
- Traction
  - Facilitate mobility
- Approximation
  - Facilitate stability
- For example… seated cervical traction vs. approximation

Stretch

- Timing with contraction effort for coordination
- Facilitation with elongation of agonist muscle &/or synergistic muscles
- Two parts
  - Short latency spinal reflex with little force
  - Functional stretch response, longer latency with more powerful contraction
- For example… hamstring stretch with overpressure

Phase 4: Motor Learning

Motor Learning

- Why?
  - Re-integration of the neuromuscular system
  - Recovery of function
- Repetition
  - Massed practice
  - Distributed practice
- Functional position, environment, etc.
  - Supportive, progressing to challenging
  - Facilitated progressing to assisted progressing to independent

Success in Neuro-rehabilitation through Motor Learning

- Optimal medical &/or surgical management
- Appropriate pain management
- Optimal timing of initiation of professional (PT) services & frequency of follow-up
- Progressive home program
- Patient cooperation

Cases, Questions, & Lab Practice

Lab Outline

-Evaluation

-Early mobilization

+Supportive positioning, standing, walking

+Sensory stimulation for withdrawal crossed extensor, extensor thrust, & protective extension response/reflex

+PNF stretch, elongation/windup, irradiation, approximation, & traction

-Integration of reflexive movements

+PNF massed flexion & rhythmic stabilization

+PNF irradiation, appropriate resistance, approximation, & traction

+Cookie stretches, transitions, assisted walking

-Tone modulation

+Postural reflexes to influence tone

+Rood Sensorimotor Technique

+PNF procedures

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PNF Procedures

- Optimal resistance
- Irradiation & reinforcement
- Manual contact
- Body position & mechanics
- Verbal command
- Vision
- Traction & approximation
- Stretch
- Timing
- Pattern