The Importance of Differential Physical Therapy Diagnostics for the Canine Lumbo-Pelvic Hip Region to the Welfare of Canine Athletes

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The Lumbo-Pelvic-Hip Region

- 7 Lumbar vertebra
- The Sacrum
- 2 Innominate Bones
- 2 Femoral Heads

- Separate but connected!
    - Interdependent in weight transference & force transmission
    - Connected via soft tissue
    - Why care?
    - Subtle lesions here can be difficult to differentiate

Pain Generators in the Lumbo-Pelvic-Hip region

- Goal of assessment is to localize or 'theorize' the site of the lesion:

Joint (facets)	Nerve
Muscle	Dura
Ligament	Disc
Fasciae	Bone
Bursae	

• Red Flags
  • Cancer
  • Aneurysm
  • Fractures
  • Spinal infection
  • Visceral pain
	• Symptomatic concerns
	  • Sleep problems
	  • Inability to urinate
	  • Inability to hold urine
	  • If the patient is a smoker

Referral to appropriate practitioner	

• Yellow Flags
  • Depression
  • Fear-avoidance
  • Pain-catastrophizing
  • Query a direct or indirect correlation in dogs.

In human medicine referral to psychologist may be appropriate Or Modification of the assessment / intervention

- NEXT:
    - Assessment attempts to 'name the lesion' or 'name the functional problem' and
    - Categorize the patient according to the suspected lesion or functional problem into a what will be the most likely successful treatment option

• Lumbar Spine Classifications:
  • Manipulation
  • Stabilization
  • Centralization
  • Stenosis
  • Neurodynamics
	• Pelvic Region / Sacroiliac Joints
	  • Form Closure
	  • Force Closure
	  • Motor Control & Timing
		• Hip Pathology Classifications
		  • Soft tissue
		  • Joint
		  • Osseous
		  • Fractures / Dislocations
		  • Nerve entrapment syndrome
		  • Paediatric disorders

THE LUMBAR SPINE

- **Anatomy**
    - 7 vertebra
    - Spinous processes (angle slightly cranially)
    - Transverse processes (long & angle cranially and slightly ventrally)
    - Accessory processes (L1 – L3/4)
    - Facet Joints (vertically aligned: L1 – L6/7)

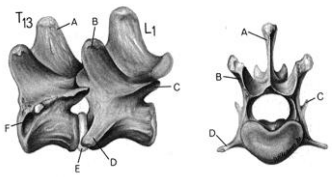
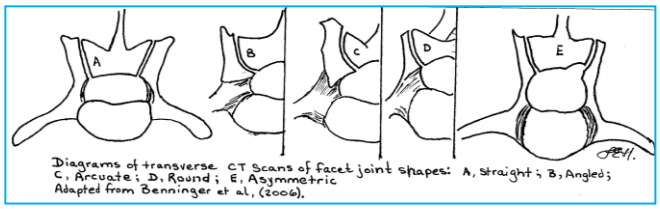


FIG. 62-24 Anatomy of the thoracic and lumbar vertebrae. (*A*, dorsal spinous process; *B*, articular process; *C*, accessory process; *D*, transverse (lateral) process of lumbar vertebrae; *E*, IVD; *F*, articulation of 13th rib)

- **Biomechanics**
    - Lordosis
        - Caudal and ventral facets
        - Reduced spinal stability
        - Ball & socket type joint
        - Intersegmental muscles stabilize



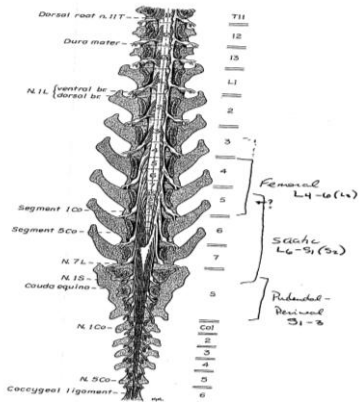
Diagrams of transverse CT Scans of facet joint shapes: A, Straight; B, Angled; C, Arcuate; D, Round; E, Asymmetric
Adapted from Benninger et al, (2006).

- Motion Patterns dependent upon:
    - Disc height
    - Facet joint angle
    - Facet joint angle difference between levels
    - Length of the lever arm

- The lumbosacral junction (in GSDs)
    - L5/6 & L6/7 are more vertically aligned
    - Larger angle difference between the lumbar spine & lumbosacral junction
    - = Inefficient facet geometry
    - = Osteophyte formation
    - = Increased facet surface area (ventral & caudal)

- Early stage lumbar DDD
    - = greater mobility (in humans)
- Herniation of the nucleus pulposis
    - = greater disc mobility (proposed in dogs)
- Inefficient facet joint geometry may
    - = facet joint adaptations, movement adaptations and subsequent disc degeneration

- Nerves
    - Cord Segments L4 – L7 sit within L4
    - Cord Segments S1 – S3 sit within L5
    - The 5 Caudal Cord Segments sit within L6



Nerve	Nerve Roots	Muscles
Femoral Nerve	L4, **L5**, L6	Iliopsoas, Quadriceps complex, Sartorius
Obturator Nerve	(L4), **L5, L6**	External obturator, Pectineus, Gracilis, Adductor
Cranial Gluteal Nerve	**L6, L7**, S1	Middle Gluteal, Deep Gluteal, Tensor Fascia Lata, Piriformis
Caudal Gluteal Nerve	**L7** (S1, S2)	Superficial gluteal, (Middle gluteal), (Biceps Femoris), (Semitendinosus)
Sciatic Nerve	**L6, L7, S1** (S2)	Biceps Femoris, Semimembranosus, Semitendinosus, Obturator internus, Quadratus femoris, Gemelli
Common Peroneal Nerve	a/a	Peroneus longus, Lateral digital extensor, Long digital extensor, Cranial tibial
Tibial Nerve	a/a	Gastrocnemius, Popliteus, Superficial digital flexor
Pudendal Nerve	**S1, S2, S3**	External anal sphincter, the external genitalia

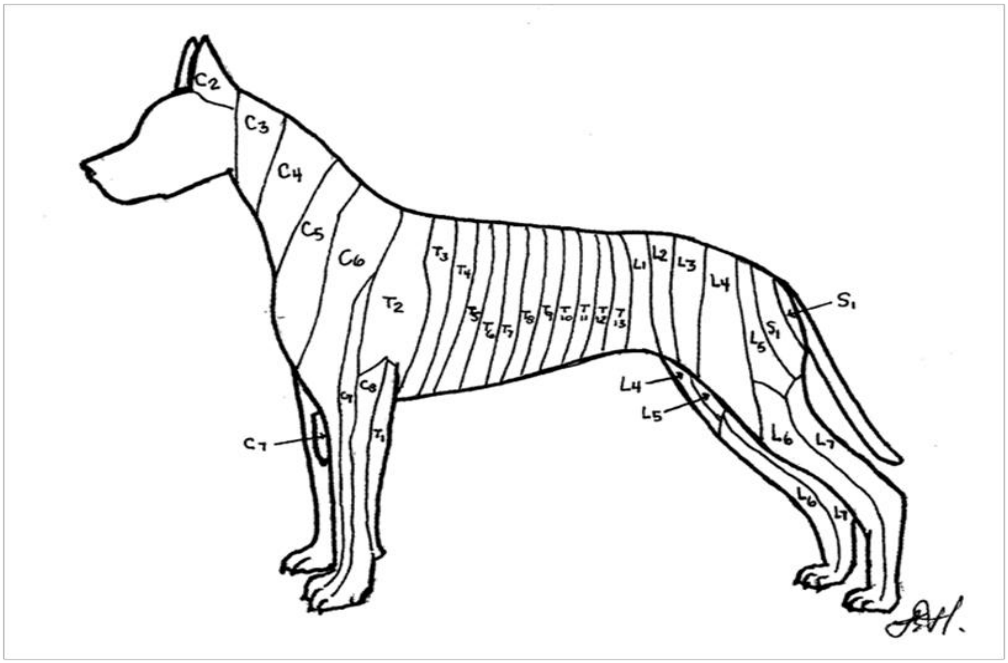
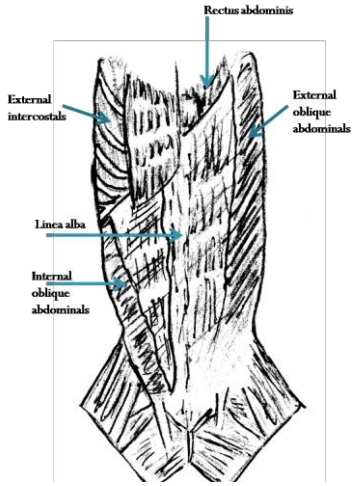


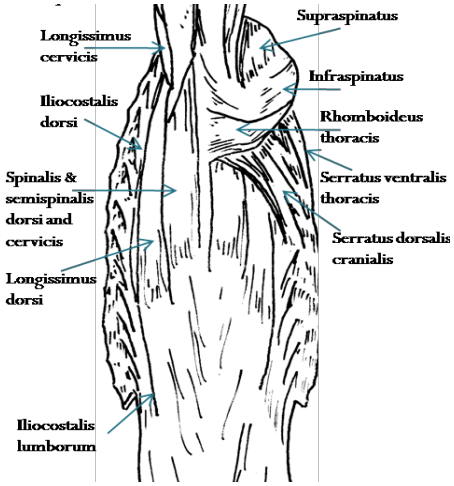
Figure 2.1 Dermatomes of the dog. (Adapted from Oliver et al 1987)

- Why care about neuroanatomy?
  - Upper Motor Neuron Lesions Signs?
  - Lower Motor Neuron Lesions Signs?
  - Myotomal reflexes?
  - Lick or chew marks along dermatomes

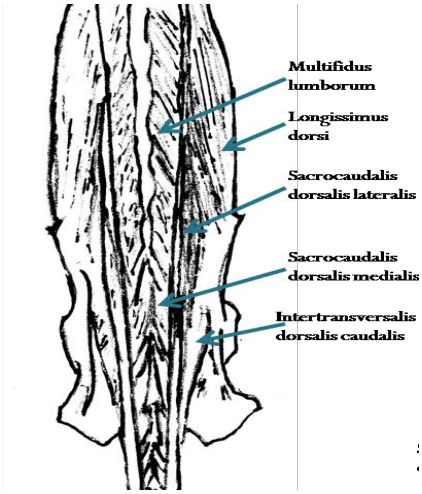
Muscles – The Movers

- Rectus abdominis, Internal & External obliques
- Spinalis, Iliocostalis, Longissimus





- Muscles - Stabilizers
  - Multifidus
  - Transverse abdominis



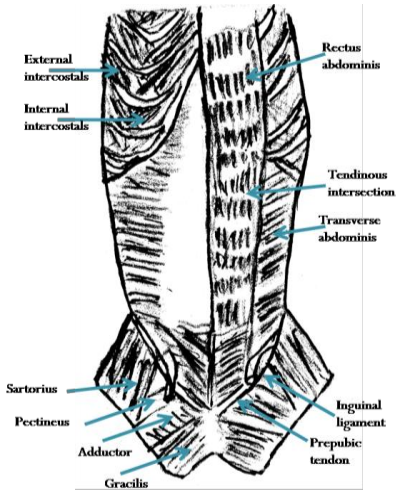
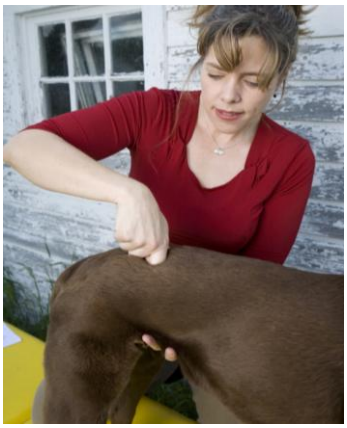
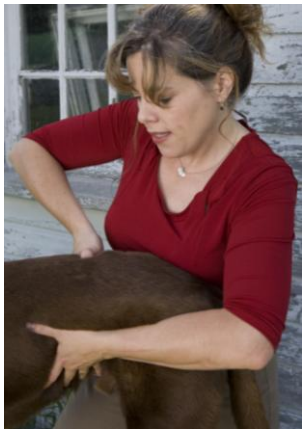


Table 3. Differential Diagnoses for Lumbar Spine Lesions		
Lesion	**Clinical Signs**	**Test**
Facet Joint Dysfunction	• Reduced athletic performance or postural adaptations • Human symptoms include referral of pain to the back, buttock, lower abdomen, groin, or legs.... so animals may display and exaggerated kyphosis (roach), excessive lordosis, spinal curvature or favouring a limb • Animal may groan to move, be slow to rise, avoid certain movements / activities (i.e. jumping into the car) • Human studies show a high correlation with lower limb sporting injuries (i.e. hamstring tears, ligament injuries, tendonopathies)	• Unilateral epaxial muscle hypertrophy in an acute lesion or atrophy in a chronic lesion • Discomfort to direct dorso-ventral pressure over the spinous process • Discomfort to lateralized pressure to the side of the spinous process (often more painful in one direction than the other) • Discomfort to flexion testing • Hypomobility/Stiffness to mobility testing (i.e the ability of the joint to fully open or close properly)

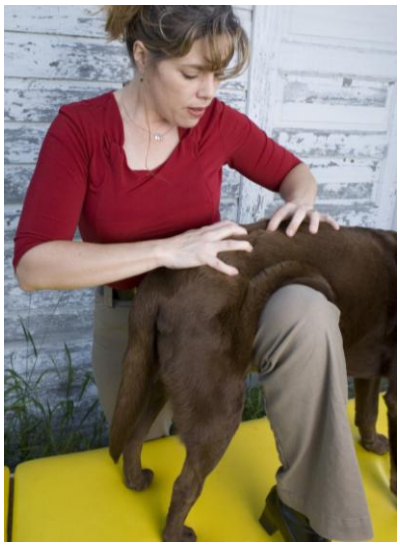
Dorso Ventral pressures



Lateral pressures



Flexion testing



Unilateral hypertrophy or atrophy

Disc Lesion
• In the region of Cord Segments
	• Antalgic posture
	• Avoidance behaviours
	• Slow to rise, displays of discomfort with certain activities
	• Neurological signs (if present)
	  • Reduced coordination and/or balance on displacement
	  • Scuffing
	  • UMN bowel/bladder is more likely if lesion is cranial to L4
	  • LMN bowel and bladder is more likely if lesion is caudal to L4
		• Very reactive on palpation of the spinous processes or adjacent soft tissues (L1 – L4/5)
		• Muscle spasms impede mobility testing (i.e. for facet joint stiffness)
		• Bilateral epaxial muscle spasms
		• Possibly poor balance on displacement
		• Possibly sluggish, slow, or diminished placing reflex
		• Possibility of a crossed extensor reflex (if lesion is cranial to L4)
		• Possibility of hyper-reflexia of tendon/muscle reflexes

Disc Lesion
• In the region of the Cauda Equina
	• Antalgic posture
	• Avoidance behaviours
	• Slow to rise, displays of discomfort with certain activities
	• Neurological signs (if present)
	  • Reduced coordination and/or balance on displacement
	  • Scuffing
	  ➢ LMN bowel and bladder is more likely if lesion is caudal to L4
	  ➢ Depending upon severity of the damage and location caudal to L4,
		• Very reactive on palpation of the spinous processes or adjacent soft tissues (L5/L6 – L7/S1)
		• Muscle spasms impede mobility testing (i.e. for facet joint stiffness)
		• Bilateral epaxial muscle spasms
		• Possibly poor balance on displacement
		• Possibly sluggish, slow, or

	may presumably have paraesthesia (manifesting as off-loading of a limb, and/or licking and chewing, or a lick granuloma) ➢ Depending upon severity of damage and location caudal to L4, may have a root signature stance	diminished placing reflex • Possibility of hypo-reflexia of tendon / muscle reflexes
Disc Degeneration	• Signs and symptoms are likely to look similar to a disc lesion affecting cord segments or the cauda equina	• Discomfort to direct dorso-ventral pressure over the spinous process • Discomfort to lateralized pressure to the side of the spinous process (symmetrically affected) • Bilateral epaxial muscle atrophy • Depending upon severity and location, may show UMNL signs on testing if disc degeneration is cranial to L4 or LMNL signs if lesion caudal to L5

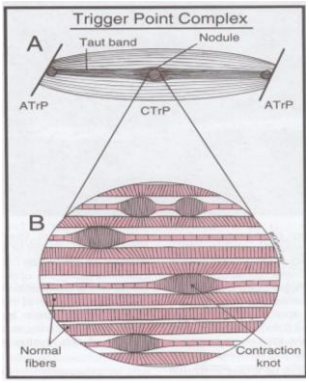
Muscle • Weakness of the abdominals • Atrophy of multifidus and epaxials • Adaptive shortening of abdominals, psoas muscles and/or latissimus • Myofascial trigger points in iliocostalis, quadratus lumborum or iliopsoas • Facilitated muscle segments (affecting iliocostalis, & iliopsoas)	Are muscle issues in the lumbar spine every primary? Not likely. • Weakness of the abdominals is often seen in association with a chronic lumbar spine dysfunction, sacroiliac joint lesion, or in juvenile or adult dogs with poor body awareness and conditioning • Adaptive shortening is more often associated with postural compensations for other pain or injuries (i.e. off-loading of a limb) • Myofascial trigger points are <u>primarily</u> activated by acute overload, overwork fatigue, direct impact trauma and by radiculopathy or <u>secondarily</u> by existing trigger points, visceral disease, arthritic joints, joint dysfunctions and by emotional distress. (Quadratus lumborum facilitation is found with suspected L/S instability) • Facilitated muscle segments may be the result of irritation to the nerve	• Abdominal weakness may display as an inability to hold the trunk and pelvis in a level position when one rear leg is slowly taken off the ground (which improves when the abdominal muscles are stimulated to contract) • Adaptive shortening may be detected by stretching the associated muscles and comparing from side to side and to other muscle groups • Trigger points can be manually palpated and are felt to be tight, reactive, fibrous bands within a muscle • Facilitated muscle segments are often bilateral, and found to be hypertonic and painful on palpation. • Manual stimulation (i.e. massage) may increase the

	root at a particular vertebral level, causing excitation and a reactive spasm in the adjacent muscle or those peripheral muscles supplied primarily by the affected nerve root (Iliopsoas facilitation is often found with any form or lumbar spinal pain)	tone in the 'facilitated' muscle

3-Leg Standing

A few stretches

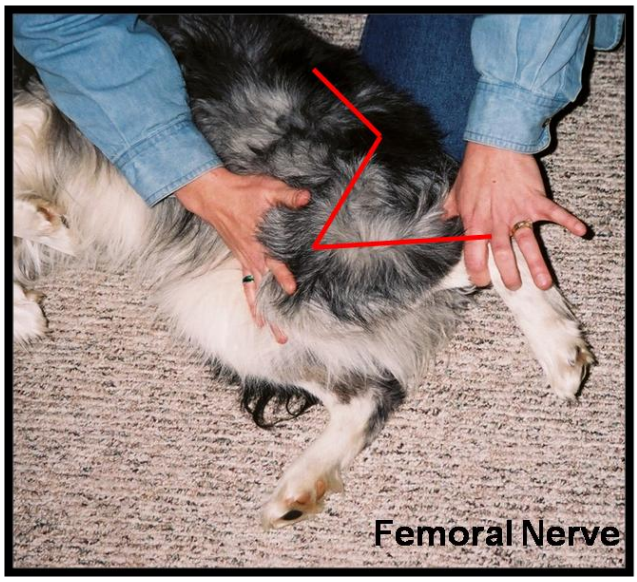
Myofascial triggerpoint



Quadratus lumborum palpation

Nerve • Nerve root inflammation • Mechanical deformation &/or damaged nerve root • Irritation of dural sleeve • Movement impairment or adverse mechanical tension	• Antalgic posture • Active movement dysfunction (i.e. poor cranial swing of the rear limb with sciatic nerve involvement) • Root signature stance or simple off-loading of a limb • Possible lick granuloma and/or licking or chewing at a limb	• Adverse responses to neural tissue provocation tests which relate specifically and anatomically to the suspected nerve / nerve root. • Passive movement dysfunction (i.e. poor mobility or resistance throughout range to 'stretch hamstrings' for a sciatic nerve issue) • Pain on palpation of specific nerve trunks which relates specifically and anatomically to the suspected nerve/nerve root. • Evidence of a local cause for the neural tissue mechanosensitization disorder • Abnormal tendon reflexes (hyper or hypo-reflexes)

Neural provocation tests / Dural tension tests

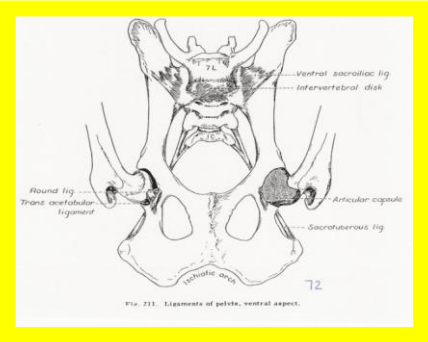


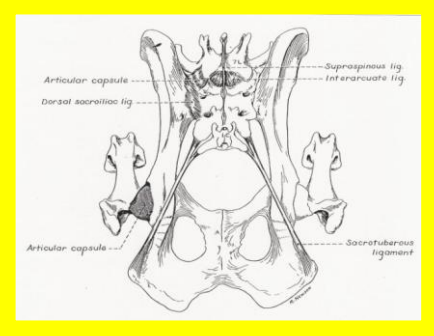
Bone • Spondylosis • Osteophytes • Facet arthrosis	• Spondylosis may manifest with no signs and symptoms or may appear just as a degenerative disc (with the symptomatic lesion being at a mobile site adjacent to the spondylosis) • Osteophytes are likely to present as a nerve lesion	• Spondylosis will yield no movement (with a boney end feel) to any manual movement tests. • Osteophytes may be detected by placing the facet joints on the suspected side into full extension/compression (which might recreate the signs and symptoms of a nerve root impingement)
Ligamentous • Instability (i.e. spondylolisthesis and lumbosacral disc disease • Poor dynamic muscle control (and excessive lordosis) • Ligamentous 'creep phenomenon' from prolonged postural positioning • Ligamentum flavum hypertrophy	• Spondylolisthesis and L-S disc disease can demonstrate LMN lesion signs (described above in the cauda equina section) • Spondylolisthesis animals may be excessively lordotic or hold themselves in a kyphotic position to reduce discomfort associated with extension postures • Animals with poor muscle control may just appear clumsy and lacking in coordination, with or without exaggerated lordosis • While it is possible to experience ligamentous creep in a human, it may not be a causal factor in canine back pain. • Ligamentum flavum hypertrophy is likely to present just as a degenerative disc disease	• Pain on palpation of the suspected vertebra, worsened with increasing pressure that creates extension • A chronic spondylolisthesis lesion will result in hypotonicity of the adjacent epaxial muscles • Exaggerated tail extension or hip extension (beyond the physiologic range of pure hip extension) may result in pain • Poor muscle control can be tested by challenging balance in stance and ambulation. • See degenerative disc disease for testing when suspecting ligamentum flavum hypertrophy

THE SACROILIAC JOINT

- **Sacroiliac Joint Dysfunction**
  - Pain in or around the region of the SIJ
  - SIJ in dogs is similar to humans to argue that SIJ dysfunction may be a potential source of back, pelvic or hindlimb pain

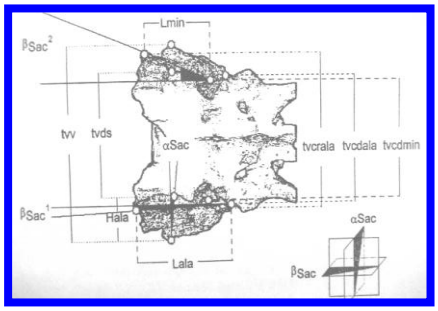
- **Anatomy & Biomechanics**
  - Synovial and cartilaginous
  - Dorsal & ventral sacroiliac joint ligaments & sacrotuberous ligament

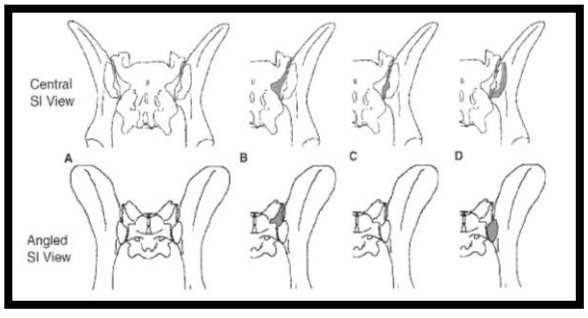




  - The SIJ articular surface and the ligamentous attachment sites are proportionally smaller in large dogs
    - (Perhaps indicating that higher forces are exerted on the SIJs in large-breed dogs)

  - 7 degrees of rotation
  - No other motions have been tested
  - Asymmetric angles of dorsoventral slope, medial-lateral slope & concavity between / within breeds





  - **Calcifications are seen on X-ray in more than 50% of dogs by the age of 1.0 – 1.5 years.**
  - Vleeming et al 1990 reported that with standard X-rays, the cartilage covered ridges and depressions in humans can easily be misinterpreted as pathologic because of the well-known over projections in SIJs, but that these cartilage covered ridges are not pathologic

Comparisons between the canine and human sacroiliac joints	
Canine	**Human**
The SIJ is both synovial and cartilaginous.	The SIJ is both synovial and cartilaginous.
Ligamentous stabilizing structures: dorsal, ventral and interosseous SIJ ligaments, sacrotuberous ligament (note: the sacrospinous ligament & iliolumbar ligament are not mentioned in canine anatomy texts).	Ligamentous stabilizing structures: dorsal, ventral and interosseous SIJ ligaments, sacrotuberous ligament, sacrospinous ligament, & iliolumbar ligament.
Mean rotation at the SIJ is 7° with a 95% confidence interval between 4 ° and 13°.	Mean rotation at the SIJ is reported between 2° and 9°.

- **Innervation:**
- Based on human & animal studies:
    - The SIJ is innervated by the dorsal rami of the first, second, and third or fourth sacral nerves (S1 to S3 or S4)
    - The SIJ has sensory innervation from the dorsal root ganglia of the first lumbar (L1) to the third sacral (S3)
    - The cranial part of the dorsal side of the SIJ could be the part most associated with pain in the SIJ

    - 29 mechanosensitive afferent units have been identified in the SIJ and adjacent tissues:
        - 26 were in the capsule and 3 in the adjacent soft tissues;
        - 28 of the 29 were classified as nociceptors and only 1 of the 29 was classified as proprioceptive.

- **Pain:**
- Thus sacroiliac joint dysfunctions may also cause pain beyond the pelvic or back region.
    - Human studies have found sacroiliac joint pain referral patterns that range from the upper lumbar spine to anywhere in the lower limb.

- Additional studies have shown that sciatic pain (in patients clear of lumbar disc or stenotic issues) may arise from the extravasation of sacroiliac joint fluid near the lumbosacral plexus or the presence of Substance P in the periarticular tissues of the SIJ.

- **Muscles - Piriformis**
    - Any SIJ lesion can cause piriformis inflammation d/t the origin of piriformis and possibly synovial fluid leakage.

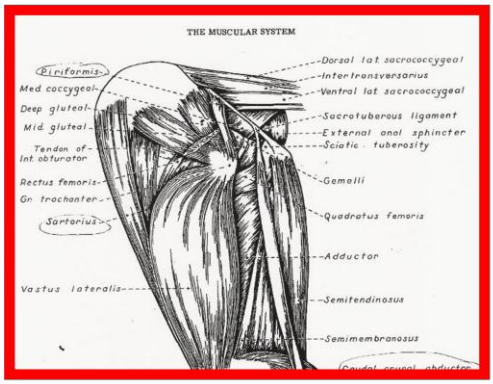


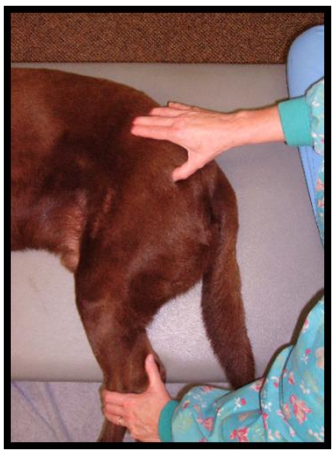
Photo courtesy of
Dr. Barbara Esteve Ratsch

- Secondary Piriformis Syndrome or Pelvis Outlet Syndrome
    - Buttock pain ± sciatica secondary to piriformis spasm
- Sacroiliac Joint Dysfunctions
    - Sacroiliac joint lesions can cause a reaction in the piriformis muscle
- Piriformis syndrome vs Disc herniations
    - Piriformis syndrome may be just as common as herniated discs in the cause of sciatica

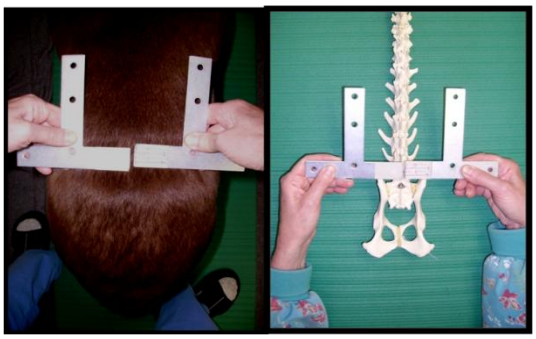
Table 5. Differential Diagnosis for a Sacroiliac Joint Lesion

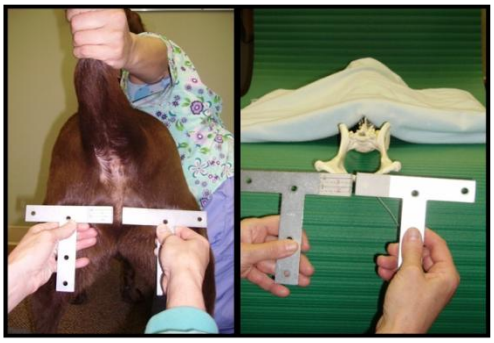
Lesion	Clinical Signs	Tests
Sacroiliac Joint Dysfunction	Not all of these signs may be present in all dogs with suspected SIJ dysfunction: • Reduced athletic performance • 'Crooked' sitting • Slowness on walks • Exaggerated kyphosis / 'tucking under' of rear end • Yelp when getting up from lying • Gait alterations, mild off-loading of a limb, lameness, or root signature stance • May lick or chew at a limb or present with a lick granuloma	Human studies for SIJ dysfunction validate the use of a 3/5 rule for testing the SIJ. Proposed tests are as follows: • Pain on palpation of the piriformis muscle • Pain on palpation of the dorsal SIJ ligaments • Presence of gluteal atrophy (if chronic) • Pelvic asymmetry • Asymmetric stiffness or hypermobility on translation tests (joint glides) or rotational tests at the SIJs • Specifics Tests ➢ Thigh thrust technique ➢ SIJ Distraction technique ➢ FABER test (flex, abd, ext rotation) of the hip • Trendelenburg sign (dropping of the pelvis/torso during a 3-leg stand)

Piriformis & Dorsal SIJ Ligament Palpation

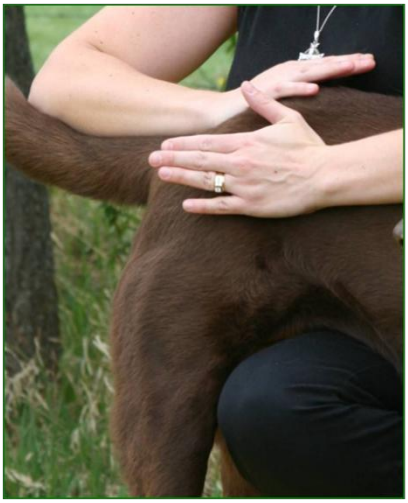


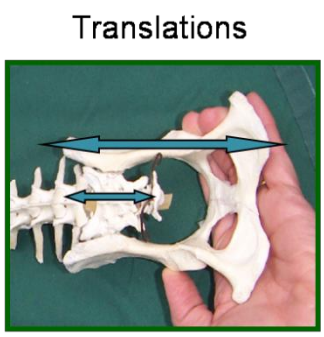
Measurement of Pelvic Asymmetry



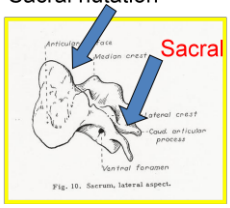


Asymmetric stiffness OR hypermobility translation tests



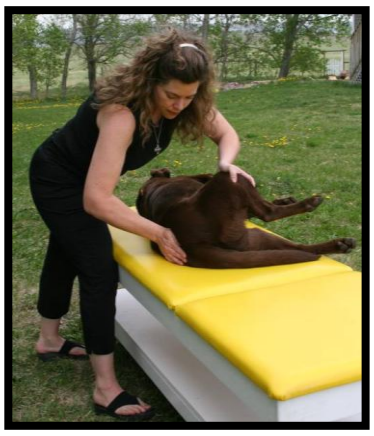


Sacral nutation



Asymmetric stiffness or hypermobility on rotational tests

- Thigh thrust technique
  - Stabilize the sacrum with one hand.
  - Apply a craniodorsal force through the femur, to the SIJ with the hip in abduction and extension
- SIJ distraction technique
  - Stabilize the spines of the sacrum with the side of your thumb (pushing them laterally – or downwards, towards the floor / treatment bed)
  - Pull the ilium away from the sacrum in the direction of the femur



- FABER test (flexion, abduction, external rotation) of the hip.... May stretch piriformis

THE HIP JOINT

- Anatomy
    - Ball & Socket
    - Deepened by acetabular labrum
    - Transverse acetabular ligament (over acetabular notch)

    - Ligament of the head of the femur (round ligament)
    - Joint capsule thickenings (but no other definite ligaments)

- ROM:
    - 45° flexion
    - 165° extension
    - 55° internal rotation
    - 50° external rotation

- **Development of the Canine Hip & CHD**
    - Puppies are born with normal hips
    - Changes may start as early as 2 weeks of age
        - Joint incongruity can lead to OA & varying degrees of dysfunction and pain.
        - Passive laxity is not independently causal to DJD
            - 5 wk old puppies whose hips were luxated and left, showed adaptive remodelling of femur & acetabulum
            - Those puppies whose hips were repositioned did not show remodelling at a 4-week check up
        - However greater laxity increases the probability of developing DJD

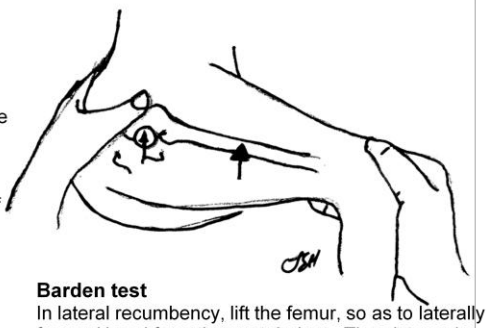
- Development of the Canine Hip & CHD
    - More muscle mass is associated with less CHD
    - Reduced muscle mass and muscle fibre size is seen in dysplastic dogs as early as 8 weeks
    - Environmental factors such as diet influence the incidence and severity of CHD

- Many immature dysplastic dogs can overcome acute CHD hip pain as they mature
    - Acetabular remodelling
    - Joint capsule fibrosis
    - Healing of microfractures

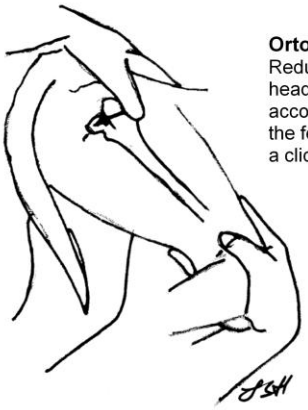
Table 6. Differential Diagnoses of the Canine Hip

Lesion	Clinical Signs	Tests
Joint • Hip Dysplasia	• Juvenile dog • Reduced exercise tolerance • Slow to rise / lie down • Preference for sitting compared to prolonged standing • Bunny hopping gait • Poor coordination • Lameness after exercise • Audible click in hip with walking	• Positive Barlow, Barden, & Ortolani test • Hips may click with balance on displacement • May have gluteal weakness & a Trendelenberg sign (see description above) • If painful: atrophied gluteals • If painful: pain on deep palpation of pectineus or deep gluteal muscles • If painful: pain to compress the joint (craniodorsally and/or medially) • If painful: pain on isolated hip extension and/or medial rotation

Barlow test
In lateral recumbency, with the stifle in moderate flexion and the hip adducted (and in slight extension), one hand pushes the femur dorsally as the thumb of the other hand detects dorsolateral displacement of the greater trochanter. Follow with the Ortolani test.

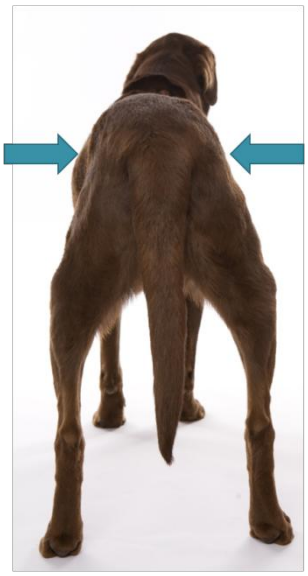


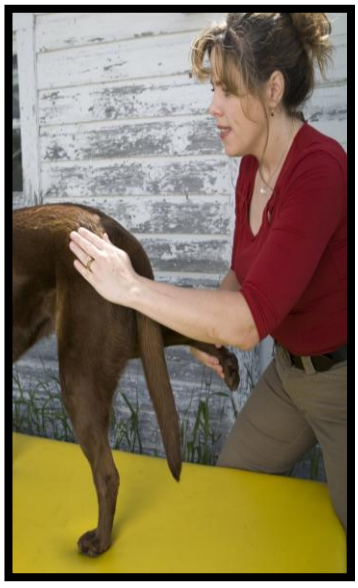
Barden test
In lateral recumbency, lift the femur, so as to laterally distract the femoral head from the acetabulum. The picture shows the technique as originally described (using a levering method with pressure being administered through your fingertips.) However, it may be more comfortable for the animal, if the examiner used a flat hand on the medial thigh to lift the femur, as the other hand spans the lateral femur with a finger on the greater trochanter to feel for a luxation, and the thumb on the lower thigh/stiffle to prevent abduction of the limb.



Ortolani Sign
Reduction of the femoral head into the acetabulum is accomplished by abducting the femur and is detected as a click or a clunk sensation.

Thumb test
Placing the thumb within the sciatic notch, externally rotate the femur. When the femoral head is in the acetabulum, external rotation of the femur causes the greater trochanter to squeeze or push the thumb between against the ischial tuberosity. When the femoral head is luxated craniodorsally, the distance between the tuber iscium and greter trochanter is increased and does not give the sensation of squeezing or pushing the thumb.





Joint • Osteoarthritis	• May occur following trauma or developmental disease at any stage of life • Lame after resting, resolution after warm up, & lame again with too much exercise	• May have gluteal weakness & Trendelenberg sign(see description above) • If painful: atrophied gluteals • If painful: pain on deep palpation of pectineus or deep gluteal muscles • If painful: pain to compress the joint (craniodorsally and/or medially) • If painful: pain on isolated hip extension and/or medial rotation

Legg-Calve-Perthes – Avascular necrosis of the femoral head

- Heritable, developmental, small & toy breeds, terriers, or Australian shepherd
- Traction or compression to the hip joint at ½ body weight can reduce flow rate of the femoral head in puppies

- Etiologic theory:
  - Occlusion of the dorsal retinacular blood supply occurs with excessive jumping on rear legs
  - Changes in femoral heads can be seen (on Roentegenography) 2 – 3 weeks before lameness or loss of muscle mass
    - Lameness corresponds with bone collapse

Joint • Legg-Calve-Perthes	• Juvenile dog • Small or toy breed, Terrier, or Australian Shepherd • Gait alterations or lameness	• Pain with hip ROM • Pain on hip joint compression • May have gluteal weakness and a Trendelenberg sign (see description above)

- **MUSCLES – causal to or impacted by hip pain**
    - **Pectineus**
        - Spasming is documented in conjunction with CHD
        - Stretch can cause spastic activity in dysplastic & normal dogs
        - Pectineus tenotomy does not prevent CHD and may result in additional pathology in CHD

        - Human: pectineus has connections to the inferior hip capsule.
        - Animal: ?
        - Correlation: Pectineus pain could equate to hip pain

Table 6. Differential Diagnoses of the Canine Hip		
Lesion	**Clinical Signs**	**Tests**
Muscle strain or tendonopathy	• Lame after resting, resolution after warm up, & lame again with too much exercise • Gait alterations • In rare cases, LMNL neurologic signs	• Pain on palpation • Pain to stretch (see table 7) • Pain to resist a muscle contraction or movement that uses the affected muscle • If neurologic involvement, LMNL reflexes • If neurologic involvement, adverse responses to neural tissue provocation tests which relate specifically and anatomically to the suspected nerve / nerve root.
Muscle imbalances • Adaptive shortening • Myofascial trigger points • Weakness	• Gait alterations • Adaptive postures • Distal limb injuries	• Adaptive shortening may be detected by stretching the associated muscles and comparing from side to side and to other muscle groups • Trigger points can be manually palpated and are felt to be tight, reactive, fibrous bands within a muscle • Gluteal weakness may display as an inability to hold the trunk and pelvis in a level position when one rear leg is slowly taken off the ground (which improves when the gluteal muscles are stimulated to contract) = Trendelenberg sign

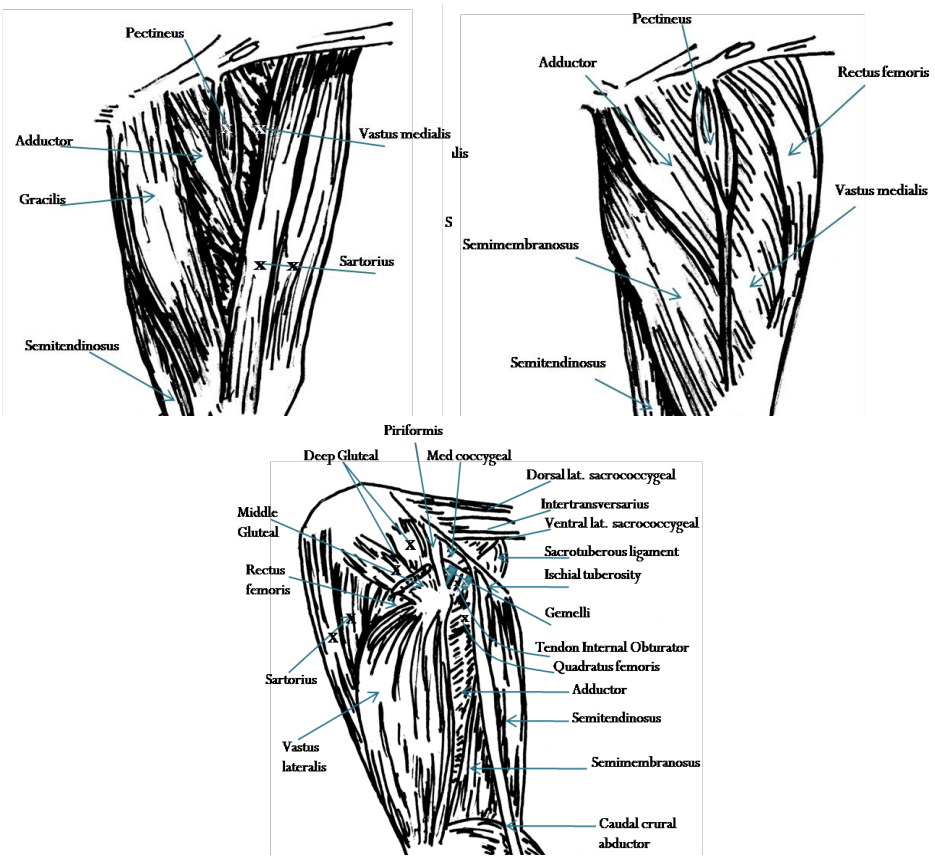
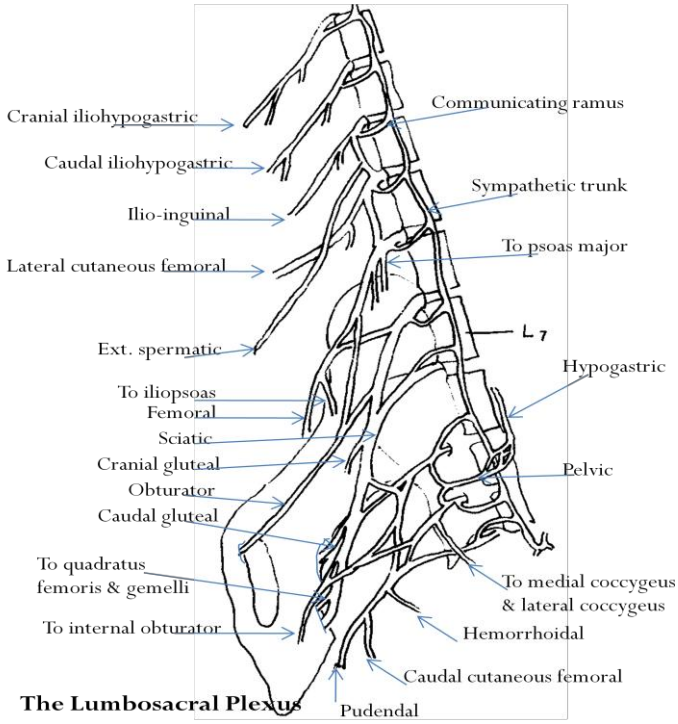


Table 7: Description of stretches designed to target specific muscles.

Muscle	Stretch
Iliopsoas	Extend the hip with internal rotation (the stifle should be extended as well).
Pectineus	Abduct the hip (The stifle should be flexed)
Gracilis	Flex the hip with the stifle extended. Add abduction of the hip to focus the stretch.
Sartorius	Extend the hip with the stifle flexed.
Rectus femoris	Extend the hip with the stifle flexed (Note: During multiple dissections, this author has attempted to stretch the rectus femoris muscle using this method, but has found that the tension produced in the sartorius muscle did not permit any stretch of the rectus femoris muscle. It was found that rectus femoris could not be put into tension with any combination of leg movements.)
Semitendinosus	Flex the hip with the stifle extended. A very slight abduction of the hip and/or flexion of the tarsus may accentuate the stretch.
Tensor fasciae latae	Adduct the limb with the hip in a slightly extended position.

Nerve Injuries

- Resultant in gait problems or lameness
    - Femoral nerve can be impacted by iliopsoas injuries
    - Sciatic nerve injuries are reported in association with CHD, hip or pelvic surgeries
    - No studies could be found implicating obturator nerve in dogs
- Neural tension tests (see lumbar spine)
- Testing results
    - Loss of range of motion compared to the other side
    - Licking or chewing associated with the testing
    - Pain associated with the testing



Conclusion

- A physical therapy systematic & methodical assessment of the lumbo-pelvic-hip region
    - Can better determine the need for further diagnostic
    - Can identify subtle issues
    - And subsequently can enhance the practice of vet medicine and is beneficial to the welfare of the patient

Layla - 75lb pitbull mix FS
HPI: One episode of apparent pain on the left hip region 2 weeks ago fairly mild resolved spontaneously. Quiet and less active Monday daytime; Monday night woke in the night screaming/crying. Able to stand, but preferred not to. O's report the left hip area looked swollen and she cried when it was touched. They massaged the area gently and Layla quieted. She woke 2 more times in the night with similar manifestation and subsequent treatment. Tuesday laid down 3 times on a short walk, would not play (usually very playful). She seemed better after an abbreviated walk. She seemed worse again after lying down.

PMHx: TPLO on this leg 2 years ago.

O/E: Timid & anxious (I know the dog she is not like this). Reluctant to allow movement of the left hind and all muscles of hip hypertonic (area warm to touch also). Warmth at L2-L4 and kyphosis, no pain on manipulation but restricted ROM of vertebral segments here compared to either side of this region. Epaxial muscles were also hypertonic. Voluntary tail movement restricted to the left, but normal to the right. PROM of tail was not restricted and not apparently painful. Coxofemoral joint was NOT subluxated and not reactive to compression, Barlow and Barden tests. She would not allow hip extension and so I could not check for capsular pattern. Quadratus lumborum was hypertonic but not reactive on palpation. Iliopsoas was difficult to interpret as Layla wouldn't allow palpation of her caudal abdomen let alone the iliopsoas (bilaterally).
No neurologic abnormalities were noted on either hindlimb, or with the perineal reflex. The superficial gluteal, middle gluteal, TFL, and possibly the piriformis were HYPERTONIC and Layla cried when they were palpated, however careful palpation of the dorsal greater trochanter did not yield discomfort.

Solomon - 8 year old male Great Dane
HPI: He suffered a recent acute onset lameness (3-week duration) of his right hind leg following a suspected trauma of his limb being caught in a hide-a-bed / sofa-bed. The chief complaint was that Solomon was walking on the dorsum of his right foot and dragging it on ambulation when found on the morning of February 11th, 2006. He was assessed by 4 different veterinarians at various clinics (including a surgical referral centre), without attainment of a definitive diagnosis before being referred to a rehab centre by the regular veterinarian for assessment and treatment.

The referring veterinarian relayed the history but did not provide any diagnosis. The report from the veterinarian at the surgical centre (February 18th, 2006) localized the lesion to right L6 – S2 partial sciatic or peroneal nerves and listed the differential diagnoses as traumatic neuropraxia, peripheral nerve tumor, fibrocartilaginous embolism, asymmetrical lumbosacral disease with nerve root compression, or focal inflammatory disease and possible concurrent testicular tumor. However, the owner had declined radiographs and MRI.

O/E: The Physical Therapy assessment occurred on March 4th, 2006. The owner was using a leash wrapped around Solomon's foot to help with foot placement. She stated that Solomon's leg weakness was sudden and had not improved or deteriorated since onset. He was no longer on any medications, but had been on steroids and muscle relaxants when first treated immediately following the injury. On visual examination, there was an open wound on the dorsum of the D3 toe on the right rear leg and generalized atrophy of all of the muscles distal to the right stifle and the central caudal thigh muscles. No ataxia or muscle guarding posture (cervical, thoracic or lumbar) was noted.

On palpation exam, there was full passive and active ROM and lack of tenderness of the cervical spine. There was no tenderness or palpable joint dysfunctions or asymmetry of the thoracic or lumbar spine or adjacent musculature. The pelvis was asymmetric, with the right ilium being caudally slipped and

dorsally rotated, and there was palpable tenderness of the piriformis muscle. Kinetic testing revealed an inability of the right ilium to ventrally rotate. All extremity joints of all four limbs displayed full passive ROM, and no heat or swelling was detected in any. Mid thigh circumference was measured as 40 cm on the left and 35 cm on the right. Calf muscle circumference as measured 4 cm distal to the stifle joint line was 22 cm on the left and 18.5 cm on the right.

Neurologic examination revealed a sluggish to sometimes absent placing reflex of the right hind foot. All other limbs were normal with this test. No crossed extensor reflex was present in either hind limb (nor in the front limbs). There was reduced sensation to toe pinch in the right hind paw, but deep pain was present. Muscle reflexes of the tibialis anterior, calcaneal tendon and semimembranosis and semitendonosis tendons were diminished. Muscle reflexes of the vastus lateralis, biceps femoris, gracilis, gluteals and the patellar tendon were normal. Pronounced atrophy and hypotonicity of semitendonosis, semimembranosis, and all of the musculature distal to the stifle was noticed.

Mystaya – 11 month old Spayed Female German Shepherd
HPI: periodic RH limb lameness.

PMHx: Previous assessments have found pelvic asymmetry / SIJ dysfunction, increased R patellar mobility (but no pain and no luxation), and discomfort of muscles surrounding R hip. At 5 months of age physiotherapist found tenderness around the R hip and to deep palpation of pectineus, as well as occasional click heard in the RH leg although specific tests (Ortolani) were not positive.
However, subsequent hip and stifle exams were negative, and X-rays of hips looked good. Two months ago, Mystaya slipped and suffered an iliopsoas injury and sacroiliac joint dysfunction on the RH.

O/E: R ilium position appears ventral and cranial. Tender on palpation of Right deep gluteal and pectineus. Tender on palpation of dorsal sacroiliac joint ligaments, piriformis and upper aspect of the caudal Sartorius. No iliopsoas pain, no spinal pain. Unable to elicit a positive Ortolani (Mystaya apprehensive and tensed with testing). No stifle, tarsus or digit issues detected.

Mila – 10 month old Lab x Collie Spayed Female
HPI: owner noticed Mila running crooked a few months earlier, and witnessed a fall 1 month ago. Had X-rays of hip, that revealed mild hip dysplasia (shallow acetabulum, narrow joint space, but no osteophytes) on LEFT side only. She tolerated 1 hour of exercise before seeming sore. Will drag LH toe with too much exercise. Mila is on 'Sasha's Blend' and Metacam.

O/E: R thigh 3 cm larger than left thigh. Right hind limb had full ROM. LH hip showed gluteal atrophy and tenderness on palpation of the deep gluteals, and had pain at the end of range of hip extension and hip internal rotation. Mila also had tenderness over L7 and BOTH dorsal SIJ ligaments and piriformis muscles. The left ilium appears dorsal compared to the right. Placing reflexes were sluggish bilaterally. No other issues were detected in forelimbs, rear limbs or the rest of the spine.

Treatment: Mobilize SIJ, traction L7S1, E-stim L gluteal and 3-leg standing and creation of home program to increase gluteal strength (fine motor control and gross strengthening).

Follow up Assessment: 1 Month later – Owner states Mila is still dragging her right hind toe. She is a bit better but still has issues. On examination, she is still very clumsy. She is tender at L4 – L6 on dorsoventral pressures and bilateral lateral pressures. The Right SIJ was tender and the right ilium was in a ventral

position. Both deep gluteal muscles were tender on deep palpation but there was no pain or subluxation/luxation detected with Ortolani testing.

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