

TOPIC OUTLINE 1 – LUMBAR SPINE, SACRUM AND COCCYX.

Introduction.

The lumbar spine.

The lumbar vertebral column consists of five separate vertebrae, and the intervertebral discs that lie between them. The lumbar vertebrae are the largest of the vertebral column and designed to bear the full weight of the upper body.

Flexion and extension are relatively unrestricted, side bending (lateral flexion) varying with age and rotation limited by the orientation of the facet joints. (Palastanga et al 1996)

The Sacrum.

The five sacral vertebrae are fused together to form the triangle shaped sacrum. It has a concave anterior or pelvic surface and a convex posterior surface. The base of the sacrum articulates with the 5th lumbar vertebra. The apex is directed inferiorly and articulates with the coccyx.

The Coccyx.

The coccyx, which is usually formed from three to four vertebrae, is normally only rudimentary. The superior surface which articulates with the sacrum has cornua or horns formed from the completely fused articular processes of the 1st coccygeal vertebra. The remainder of the coccygeal vertebrae consist of small, spherical shaped bones.

The intervertebral disc.

The intervertebral discs make up approximately 25% of the total length of the vertebral column. Each intervertebral disc consists of two basic components: a peripheral Annulus Fibrosus, and a central Nucleus Pulposus.

The Annulus Fibrosus. (AF).

The AF is made up of concentric collar like rings of collagen fibres that criss-cross each other to increase the strength and accommodation of torsion forces.

The Nucleus Pulposus. (NP).

The NP is a gelatinous mass of mucoid material. Embryologically, the NP is a remnant of the notochord. The fluidic nature of the NP allows it to be deformed under pressure, but as a fluid, its volume cannot be compressed. This allows the NP to transmit applied pressure in all directions.

The discs are avascular, receiving a blood supply via osmosis and the outer third receiving a nervous innervation via the sinuvertebral nerve.

The pain sensitive structures that lie in close proximity to the disc include the Anterior and Posterior Longitudinal Ligament, the vertebral body, the nerve root and the capsule.

Low Back Pain.(LBP)

“Low back pain is a leading cause of disability. It occurs in similar proportions in all cultures, interferes with quality of life and work performance, and is the most common reason for medical consultation” – WHO 2003

The onset of LBP is often associated with bipedal ambulation. Theories propose that this transformation - the mechanics of locomotion make the lumbar spine susceptible to disc disease.

Macro and micro trauma as well as body habits that alter the biomechanics, predisposes the lumbar spine to degenerative diseases and chronic back pain.

Descriptions of treatment for LBP date back to Hippocrates (460 – 370 BC) who reported joint manipulation and use of traction.

Once a complete case history has been taken, and an effective set of differential diagnosis formulated, a regional observatory inspection is carried out. The objective of observation is to help confirm or dismiss a hypothesis made in the differential diagnosis.

Initial Regional Inspection.

Factors to consider on lumbar spine observation include :-

- Gait. Antalgic gait, Trendelenburg gait, Foot drop gait, Spastic gait.
- Ease of movement.
- Spinal curves, Lordosis, Scoliosis, Kyphosis.
- Pelvic obliquity, Anterior/posterior pelvic tilt.
- Leg length discrepancy, levels of iliac crests, gluteal folds etc...
- Scars, surgical/ traumatic
- Hair tufts lumbar spine Faun's beard – Spina bifida.
- Vascular trophic changes in the lower limb.
- Atrophy.

(Ref:- Passor, Musculoskeletal physical examination competencies list. 2000-20001).

Once a complete regional inspection is carried out, a specific palpation of anatomical structures is conducted in order to identify possible pain sensitive structures.

Palpable Structures – Bony Structures.

- Iliac crests.
- Posterior Superior Iliac Spines (PSIS)
- Posterior Inferior Iliac Spines (PIIS)
- Median sacral crest
- Sacral hiatus
- Sacral cornuae
- Coccyx
- Inferior lateral angles of the sacrum (ILA)
- Lumbosacral junction
- Spinous processes of L1-L5.

The patient is in the prone position through out the palpation of the bony landmarks.

Iliac Crests.

The iliac crests are palpated bilaterally, an assessment is made on tissue quality, symmetry and bony abnormalities.

Posterior Superior Iliac Spines (PSIS)

Continue your palpation posteriorly from the iliac crests, dropping onto the PSIS's. As with the iliac crests the PSIS's are assessed bilaterally checking for levels or even tenderness. Tenderness may indicate a ligamentous strain.

Posterior Inferior Iliac Spines (PIIS)

The PIIS's are much smaller and harder to palpate than the PSIS's and lie approximately 1cm inferior to the PSIS's. From the contact on the PSIS's, move inferiorly into the soft tissue and apply a firm pressure. The PIIS's may not feel distinctly obvious, but their position is less important than the presence of pain, which may indicate a ligamentous injury.

Median Crest of the Sacrum.

This is the central ridge of protuberances that runs the entire median length of the posterior sacrum.

Relocate the PSIS's and contact a point approximately half way between the two PSIS's. At this point you should be able to feel a line of rudimentary spinous processes running caudally from the base of the sacrum.

Sacral Hiatus.

Follow the median sacral crest until you palpate a small depression. This depression is known as the sacral hiatus. The sacral hiatus represents the S5 vertebra. The rudimentary vertebra has an absent neural arch and this is where the terminal sacral and coccygeal nerves exit from the spinal canal. The depression is filled with a protective fat pad, which makes it difficult to palpate. Tenderness may indicate a sacrococcygeal joint dysfunction, or a neural injury.

Sacral Cornuae.

The sacral hiatus is limited laterally by the rudimentary neural arch which have formed a left and right horn- like protuberance called the sacral cornuae. From the sacral hiatus, palpate bilaterally to locate the cornuae. The cornuae are usually tender as they are the attachment point of the sacrococcygeal ligaments.

Coccyx

The coccyx is an important landmark and is often not assessed because of an uncertainty of its location and the concern that the palpation may be too invasive. In fact, the coccyx is simple to palpate externally, and the process is not too invasive.

Place the heel of your hand on the sacral base, with your fingers directed inferiorly. Allow your middle finger to palpate the median sacral crest. Continue to palpate inferiorly with your middle finger until you palpate the sacral hiatus. Approximately 2cm inferior from the sacral hiatus you will be in contact with the coccyx.

The coccyx is assessed for position, as well as reproduction of pain. Coccyx pain is a common presentation, especially if it has been altered in position secondary to pregnancy.

Inferior Lateral Angles.

From the coccyx, the sacral cornuae are contacted. Palpate immediately inferiorly onto the posterior aspect of the sacral apex. Continue to palpate inferiorly into the soft tissue zone of the gluteal muscles. A deeper contact is applied until a bony structure is palpated. This bony tissue is the most inferior aspect of the sacrum, the inferior lateral angles.

Lumbosacral Junction.

To palpate the Lumbosacral junction, a contact is made once again on the PSIS's. palpate medially into the sacroiliac sulcus, and apply pressure anteriorly onto the posterior aspect of the sacrum.

Continue your palpation superiorly until a soft tissue depression is felt. Palpating medially a bony ridge should be palpated, this structure is the spinous process of the 5th lumbar vertebra. (occasionally, the spinous process of L5 may be difficult to palpate, or a “step” may be palpated, this may indicate the possibility of a Spondylolisthesis).

The palpation is continued superiorly, with the aim of contacting the spinous processes of L4-L1. The spinous processes are assessed for abnormalities, positioning and tenderness which may indicate vertebral restrictions.

Following the palpation, active and passive orthopaedic testing is carried out.

Orthopaedic Examination.

It is important to remember that with all orthopaedic tests we are trying to assess range of movement and in some cases reproduce the symptoms the patient is presenting with, **BUT IF AT ANY TIME DURING YOUR TESTING THE PATIENT REPORTS PAIN YOU MUST STOP AS PAIN NEGATES THE TEST.**

Normal Range of Motion*

- Flexion – 60°
- Extension – 35°
- Side bending – 20°
- Rotation – 5°

(ref. The physiology of the joints, Volume 3 – the trunk & vertebral column. I.A.Kapandji)

L1-2, Flexion, 8°. Extension, 5°. Side bending 5.5°. Axial rotation 1°.

L2-3, Flexion, 10°. Extension, 3°. Side bending, 5.5°. Axial rotation 1°

L3-4, Flexion, 12°. Extension, 1°. Side bending, 5°. Axial rotation 1.75°

L4-5, Flexion, 13°. Extension, 2°. Side bending, 2.25°. Axial rotation 1.75°

L5-S1, Flexion, 9°. Extension, 5° Side bending, 1°, Axial rotation, 0.25°

(ref. The biomechanics of back pain, Adams, Bogduk, Burton, Dolan.)

*

These degrees of motion are subjective and only a guide. Factors including age, occupation, body type etc.. will have an effect on range of motion.

Active Movements.

With the patient standing.

- Flexion
- Extension
- Side Bending
- Rotation.

Passive Movements.

With the patient sitting.

- Flexion
- Extension
- Side Bending
- Rotation.

Once a completed active and passive examination has been carried out, if indicated by either the case history or the examination findings specific special tests can be performed to help formulate a diagnosis.

Special Tests.

Lumbar Spine Palpation.

If during the case history the practitioner suspects a possible Spondylolisthesis a spinal palpation is indicated.

The patient is standing and SLIGHTLY flexed. The practitioner palpates the spinal processes feeling for a "step".

The palpation is also carried out in a side lying position with the patient's knees slightly flexed. As palpating for a possible spondylolisthesis is difficult, the side lying position makes the palpation easier.

Spinal palpation is not accurate, and an oblique/lateral view lumbar spine x-ray is an accurate diagnostic tool.

The results are recorded as what is palpated. i.e. "step palpated L5".

Nerve Root Irritation. (NRI)

Nerve root irritation is a common presentation. Causes range from discal herniations to osteophytic irritation. Predisposing factors include age, occupation, body type and suggestion have been made as a direct result of bipedal ambulation.

Symptoms of a NRI may include, radiating pain and paraesthesia along a specific dermatome.

Traction (via an osteophyte/disc matter) as well as chemical irritation (inflammation) of the nerve root are factors which may result in radiating pain.

(ref Clinical Anatomy of the Lumbar Spine and Sacrum, N. Bogduk).

Nerve root irritation testing.

When assessing for a nerve root irritation care must be taken not to aggravate symptoms by repetitive unnecessary testing. Palpating the lumbar erector spinae muscles in a weight bearing position (standing) may cause reproduction of symptoms into the lower extremity, along a specific dermatome. It has been suggested that palpation of the inflamed superficial muscles causes further irritation (chemical) of the inflamed nerve root, therefore reproducing symptoms. (ref Clinical Anatomy of the Lumbar Spine and Sacrum, N. Bogduk).

Straight Leg Raising Test (SLR Test).

The SLR test assesses for nerve root irritation affecting the lower lumbar and upper sacral nerve roots.(L4/5 S1/2)

The hip joint in this test is used as pulley, to apply traction onto the sciatic nerve.

Like all orthopaedic tests the asymptomatic side is tested first.

Crossed Straight Leg Raising Test (X-SLR Test)

With the patient in a supine position, the asymptomatic leg is lifted (with the knee locked) and slight adduction and medial rotation introduced, to as far as is comfortable for the patient. During the leg lifting the patella is oscillated to ensure the quadriceps muscles are relaxed making the test completely passive.

The purpose of the test is to assess the normal range of movement for the patient, but also asking the patient if symptoms are reproduced down the symptomatic leg. If the disc injury is severe, raising the asymptomatic leg will reproduce symptoms into the symptomatic leg. This test is only 75% accurate.

On occasion, a disc injury may result in irritation of both the vertebral segment's nerve roots (central disc injury). Lifting the leg will reproduce symptoms in to both lower extremities.

SLR.

Once the X-SLR test is carried out, the symptomatic leg is lifted in the same way as described above.

The leg is lifted slowly asking the patient throughout the test if symptoms are reproduced.

As soon as the patient reports reproduction of symptoms, the leg is lowered until the symptoms are no longer present. The foot is then dorsiflexed at the ankle. (**Bragard's Test**). The dorsiflexion further stretches the sciatic nerve.

If no symptoms are reported with the Bragard's test, with the leg in the new lowered pain free position, the patient is asked to flex the neck. This neck flexion stretches the meninges, which will in turn irritate an inflamed nerve root. (**Dural stretch test**).

The SLR test assesses for NRI, BUT is used in conjunction with a full neurological screening.

Previous interpretation of the SLR test suggested that pain reproduced at different degrees was indicative of specific conditions ranging from sacro-iliac dysfunction, NRI or hamstring hypertonicity. Recent studies suggest that this information is invalid.

For a SLR test to be considered "positive", radiating pain and parasthesia will be reported in the posterior aspect of the thigh past the knee, or along a specific dermatome.

The test is recorded to what the patient reports, and at what degree symptoms are reported.

Bowstring Test.

As hamstring hypertonicity can mimic NRI, the bowstring test assesses for hamstring hypertonicity.

The patient is supine, and their hip and knee is flexed to 90 degrees. The patient knee is slowly straightened until symptoms are reproduced. (the test may have to be adapted as the patient may be to acute). Once the symptoms are reproduced the knee is lowered to a pain free degree. The practitioner then applies pressure on the tendons of biceps femoris, semimembranosus/tendonosus and the sciatic nerve in the popliteal fossae.

If pain is reported on palpation of the tendons it is suggested of hamstring hypertonicity. If the pain is reproduced on palpation of the sciatic nerve it may be indicative of a NRI.

The test is recorded to the symptoms the patient reports as well as which tendon/nerve reproduces pain.

Valsalva Manoeuvre.

This test is controversial as its reliability is questionable. The valsalva manoeuvre can be used if during the case history the patient reports pain in the affected lumbar spine on coughing/sneezing, inspiration or bearing down.

The patient is asked to “ take a deep breath in and bear down”. This process will reproduce pain in the affected lumbar vertebra.

If pain is reported it suggests a disc protrusion, the test will increase intra thecal pressure, therefore protruding the disc even more.

Neurological testing.

After carrying out the SLR tests, a neurological screen is performed assessing for a lower motor neurone lesion. The neurological tests take the form of :- segmental muscle power, deep tendon reflexes and a sensory examination. The clinical findings allow an understanding of extent of involvement and possibly severity of the injury.

Lumbar Traction.

Lumbar traction is applied to decompress the lumbar spine and possibly reducing the causative factor of the NRI, therefore reducing symptoms. If there is a suspected ligamentous injury symptoms will increase.

The patient is seated with their arms crossed onto opposite shoulders. The practitioner then cups the elbows and applies a traction. The traction is held for 10 seconds and symptoms recorded.

Lumbar Compression.

Lumbar compression assesses for a possible intervertebral disc injury causing NRI.

It is important to remember that compression will aggravate symptoms, therefore once pain is reported the test is stopped.

The patient is seated and their lumbar spine supported if necessary. The practitioner then applies a progressive compression through the patient's shoulders.

If, during the initial compression symptoms are not reproduced the patient is positioned into a slightly flexed posture and side bent to the opposite side of the symptoms (still seated). A compression is applied, awaiting reproduction of symptoms.

The final stage of the compression test is to position the patient in a slight flexed posture with side bending towards the symptomatic side. As above a compression is applied, awaiting symptoms. It is important to remember that once symptoms are reproduced the test must be stopped.

A “positive” test is recorded if the patient reports pain radiating along a specific dermatome.

Reverse SLR Test.

With the SLR test nerve irritation affecting L4/5 S1/2 is being assessed. The reverse SLR test is assessing for a femoral nerve compression L2/3/ (4).

A femoral nerve irritation is rare, but possible.

The patient is prone, and the knee is flexed to 90 degrees. The practitioner places their hand under the patient’s thigh and extends the hip. The practitioners other hand supports the pelvis.

If the femoral nerve is irritated, the reverse SLR should result in radiating pain along the anterior aspect of the thigh in the femoral nerve distribution.

The results are recorded as with the SLR test.

NB. Laying the patient prone may aggravate symptoms; therefore the test may be carried out side lying.