PREGNANCY & LOW BACK PAIN

Dr Martin Schmaltz, DC, DIANM, CCIC

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OUTLINE

I. Prevalence
II. Definition
III. Etiology
IV. Risk Factors
V. Clinical Presentation
VI. Differential Diagnosis
VII. Examination
VIII. Prognosis
IX. Management

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BIO& QUALIFICATIONS

- 1984 Graduate of Life Chiropractic College – Atlanta
- Currently practicing in the Metro St Louis area
- Adjunct Logan University School of Chiropractic
- Diplomate International Academy of Neuromusculoskeletal Medicine (DIANM), Board Certified Chiropractic Orthopedist
- Certified Chiropractic Insurance Consultant – Licensed in Missouri
  - Peer Review Certification, *Identifying causality, proper diagnosis coding, effects of co-morbidities, appropriate treatment protocols and documentation along with the determination of maximum medical improvement or static and stationary.* Texas Chiropractic College

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- Independent Medical Examination Certification, *documenting the essentials of causal relation, apportionment and permanent impairment, appropriate physical examination techniques, documentation and report writing.* Texas Chiropractic College
- Chiropractic Sports Physician Program - Los Angeles Chiropractic College
  - Post doctorate program in sports injury and physical fitness
- 100 hour DOT Physical Examination
- 100 Hour Acupuncture Course

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PREVALENCE & DEFINITION

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PREVELENCE

Musculoskeletal pain in pregnant women is often considered temporary and self-limiting

Due to lack of clear definition, the prevenance of LB or PGP varies from author to author

- **"**From 50% to 70% of women experience some form of low back or pelvic pain during pregnancy, and women who experience severe LBP or PGP are at high risk for back pain for more than 3 to 10 years after delivery" (1)
- …" pain may persist for prolonged periods in some patients, ranging from 6-24 months in more than 20% of the population " (1)

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PREVELENCE

- "Pain in the lumbar spine and pelvic region is a frequent complication of pregnancy and delivery. The prevalence of pregnancy-related low back and pelvic pain (PLBP) varies widely from 14.2% to 56% " (2)
- "The prevalence is reported to range from 24% to 90%, mainly due to the lack of a clear definition and classification of the condition" (3)
- Up to 40% of patients report musculoskeletal pain 18 months after delivery, and 1/5th of these women have severe LBP leading to major personal, social, or economic problems.(16)

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PREVELENCE

Pregnancy-related LBP contributes substantially to health care costs

- in Scandinavian countries1/5th of the women take up to 7 weeks sick leave due to back pain (16)
- 94% of women who experienced LBP during first pregnancy, experience LBP in subsequent pregnancy. 2/3rd of these experience disability and require sick leave (16)
- 19% of women with pain during first pregnancy report avoidance of a future pregnancy out of fear of recurrence of the musculoskeletal symptoms (16)

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DEFINITION

- Pain localized at the pelvic girdle during and after pregnancy has been identified and recorded as an entity since the 4th century BC by Hippocrates (1)
- Defining low back or pelvic pain in the literature is at times complicated and a little confusing
- Some of the current terminology includes:
  - Lumbar Pain (LP)
  - Low Back Pain (LBP)
  - Pelvic Girdle Pain (PGP)
  - Peripartum Posterior Pelvic Pain (PPPP)
  - Pregnancy Related Low Back pain (PLBP)
  - Pregnancy Related Pelvic Girdle Pain (PPGP)
  - Pregnancy Related Lumbopelvic Pain (PRLP)

In most instances the pain is defined by the location

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So, no matter which definition you use, many women suffer from LBP, PGP during pregnancy!

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PHYSIOLOGICAL CHANGES DURING PREGANCY

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The physiologic changes during pregnancy may predispose women to back pain (7)

- The increased lumbar lordosis along with increased laxity of the joints of the lumbar spine and pelvis with the added weight of the gravid uterus causes a shift of the center of gravity forward and an increased mechanical burden on the low back
- The abdominal musculature stretches as the uterus grows and restricts the muscles contractile strength
- The muscles of the low back work harder to maintain upright posture

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- Relaxin is a hormone secreted by the corpus lutea and has been identified as the major contributor to joint laxity during pregnancy
  - However not proven to be a cause of LBP – will look at later
- At 10-12 weeks, there is increased mobility of the sacroiliac joints and widening of the symphysis pubis due to relaxin.
- The strong sacroiliac ligaments which normally resists forward flexion of the ala becomes lax
- Note that changes of weight gain, maternal obesity, and fetal weight at term have not been found to be related to pregnancy-related back pain

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ETIOLOGY

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ETIOLOGY

There is a lot of debate in the literature as to the cause of LBP or PGP during pregnancy.

Proposed mechanisms include:

- Mechanical
- Hormonal
- Circulatory
- Psychosocial factors

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ETIOLOGY

Mechanical

- Due to the changes of pregnancy, it can affect the facet joints, back musculature and ligaments
- Due to weight changes, there is a forward shift in center of gravity
- Postural changes develop to compensate for the shift
- Increased lumbar lordosis
- Increased stress on facets, discs, ligaments
- Also, ligament laxity or instability of the sacroiliac joints

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ETIOLOGY

Hormonal

- Relaxin (4, 14)
- Common belief that increased relaxin levels associated with pregnancy related pelvic pain
- Somes studies suggest PPGP linked to increased pelvic mobility which leads to pelvic joint instability and pain
- Relaxing of pelvic ligaments begins 10^{th} – 12^{th} week, considered to be due to hormonal changes
- This is attributed to relaxin which is secreted by the corpus luteum and the placenta.

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ETIOLOGY

Hormonal

- Levels rise significantly during the first trimester and remain steady thru delivery, then rapidly decrease the first few days post partum.
- There is debate in the literature regarding if relaxin causes instability that leads to PRPP
- Aldabe, et al. conducted a literature review. Their *"aim was to determine the level of evidence for a high level of relaxin during pregnancy being associated with PPGP"*
- **Conclusion** - Three of four high quality studies could not find a positive association between relaxin and PPGP.
- Per Vøllestad, "relaxin contributes to laxity of pelvic joints in pregnancy. Yet, no evidence of relaxin having an impact on symptoms or perceived disability was found"

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ETIOLOGY

Circulatory

- The enlarged uterus can put pressure on the vena cava, especially at night while lying down,
- Along with increased fluid retention, can lead to venus congestion and hypoxia in the lumbar spine. (5)

Psychosocial factors (6)

- Factors that can increase low back pain include:
  - Pain related catastrophizing
  - Depression
  - The pain intensity

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ETIOLOGY

Visceral Causes of Low Back Pain in Pregnancy (7)

GENITOURINARY	
	Urinary tract infection
	Kidney stones
	Pyelonephritis
	Cystitis
	Urethritis
GYNECOLOGIC	
	Ovarian cyst or torsion
	Uterine dysfunction or placental abnormality
	Pelvic inflammatory disease
GASTROINTESTINAL	
	Constipation
	Hemorrhoids
	Irritable bowel syndrome
	Hernia

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RISK FACTORS

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RISK FACTORS (5)

- "There has been a lot of debate concerning the risk factors of LBP during pregnancy and many contradictive articles have been published. "
- History of pelvic trauma, chronic LBP and low back pain during a previous pregnancy are the most common and widely accepted risk factors
- 85% of women with back pain in a previous pregnancy will develop back pain in a subsequent pregnancy
- The number of previous pregnancies also seems to increase the risk
- History of LBP before pregnancy

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RISK FACTORS (5)

- LBP during menstruation
- Exercise on a regular basis before the pregnancy seems to reduce the risk of PLBP
  - However, the same it is not true regarding exercises and PGP
- A study using the Roland questionnaire suggests that the male sex of the fetus may be a predictive factor
- Diagnosed hypermobility, more common in women with LBP

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RISK FACTORS (5)

Hypermobility and Pelvic Girdle Pain (13)

- Joint hypermobility (JH) places a great level of strain on an affected individual's musculoskeletal system
- It occurs secondary to increased elasticity of the soft tissues that support a joint, allowing greater range of motion
- Studies have found that females with JH are at increased odds of developing PGP during pregnancy than those who do not have JH
- The prevalence of PGP during pregnancy is found to be higher in individuals suffering from Hypermobility Spectrum Disorder (HSD) (26%) compared to those who were controls (7%)

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RISK FACTORS (5)

Hypermobility and Pelvic Girdle Pain (13)

- Joint hypermobility (JH) is classified according to position on the hypermobility spectrum, which ranges in severity from asymptomatic joint hypermobility, to hypermobility-type Ehlers-Danlos Syndrome (hEDS)
  - Asymptomatic Generalized Joint Hypermobility (Asymptomatic GJH)
  - Asymptomatic Peripheral Joint Hypermobility (Asymptomatic PJH)
  - Asymptomatic Localized Joint Hypermobility (Asymptomatic LJH)
  - Generalized Hypermobility Spectrum Disorder (G-HSD)
  - Peripheral Hypermobility Spectrum Disorder (P-HSD)
  - Localized Hypermobility Spectrum Disorder (L-HSD)
  - Historical Hypermobility Spectrum Disorder (H-HSD)
  - Hypermobility – Type Ehlers-Danlos Syndrome (hEDS)

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RISK FACTORS (5)

Hypermobility and Pelvic Girdle Pain (13)

- Studies investigating the pelvic joints and hypermobility have found that pelvic pain is secondary to altered biomechanics & transmission of forces via the spine
- Altered biomechanical loading and kinematics secondary to JH and instability overloads and injure joints
- Repetitive microtrauma to its supporting structures can cause soft tissue injuries and arthralgias
- Impaired proprioception has also been found in patients with JH, and it has been identified as a risk factor for injury

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RISK FACTORS (5)

Hypermobility and Pelvic Girdle Pain (13)

- Soft tissue structures surrounding the pelvis play a primary role in its stabilization.
- They can be divided into subgroups known as the longitudinal, anterior oblique and posterior oblique pelvic slings. These group muscles to their particular role in stabilization
- Poor coordination, or differences in their strength can lead to pelvis instability by reducing the tension on ligaments and tendons.
- In hypermobile patients, the laxity of soft tissues impairs the compressive forces normally generated to stabilize the pelvis.
- This results in altered transfer of load from the spine to the lower limbs via the SIJ, making the joint prone to degenerative disease

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ASSESSING JOINT HYPERMOBILITY

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RISK FACTORS (5)

Assessing Joint Hypermobility

- The Ehlers-Danlos Society
  - The Beighton Scoring System measures joint hypermobility on a 9-point scale. The joints assessed are:
    - Knuckle of both little fingers
    - Base of both thumbs
    - Elbows
    - Knees
    - Spine

https://www.ehlers-danlos.com/assessing-joint-hypermobility/

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RISK FACTORS (5)

Assessing Joint Hypermobility

- The Beighton Scoring System
- A positive Beighton score is any score greater than or equal to:
  - 5/9 points in adults
  - 6/9 points in children (before puberty)
  - 4/9 points in adults over age 50

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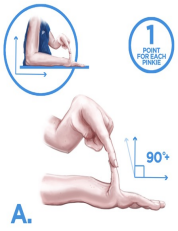
RISK FACTORS (5)

The Beighton Scoring System

5th FINGER/'PINKIES'

- Test both sides:
- Rest palm of the hand and forearm a flat surface with palm side down and fingers out straight
- Can the fifth finger be bent/lifted upwards at the knuckle to go back beyond 90 degrees?
- If yes, add one point for each finger



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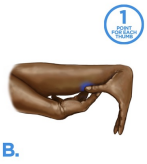
RISK FACTORS (5)

The Beighton Scoring System

THUMBS

- Test both sides:
- With the arm out straight, the palm facing down, and the wrist then fully bent downward, can the thumb be pushed back to touch the forearm?
- If yes, add one point for each thumb.



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RISK FACTORS (5)

The Beighton Scoring System

ELBOWS

- Test both sides:
- With arms outstretched and palms facing upwards, does the elbow extend (bend too far) upwards more than an extra 10 degrees beyond a normal outstretched position?
- If yes, add one point for each side

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RISK FACTORS (5)

The Beighton Scoring System

KNEES

- Test both sides:
- While standing, with knees locked (bent backwards as far as possible), does the lower part of either leg extend more than 10 degrees forward?
- If yes, add one point for each side

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RISK FACTORS (5)

Assessing Joint Hypermobility - The Beighton Scoring System

SPINE

- Can you bend forward and place the palms of your hands flat on the floor in front of your feet without bending your knees? If yes, add one point.
- If yes, add one point

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RISK FACTORS (5)

Assessing Joint Hypermobility

- The Beighton Scoring System
- A positive Beighton score is any score greater than or equal to:
  - 5/9 points in adults
  - 6/9 points in children (before puberty)
  - 4/9 points in adults over age 50

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DIFFERENTIAL DIAGNOSIS

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DIFFERENTIAL DIAGNOSIS

The more common musculoskeletal conditions resulting in back and pelvic pain:

- Lumbar Disc
- Facet Joints
- Sacroiliac Joints
  - The characteristics of the pain can help identify the cause
- Hip Pathology

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DIFFERENTIAL DIAGNOSIS

Lumbar Disc

- Typically, under 50 years of age
- Pain is axial
- Pain is worse with sitting and getting up from sitting,
- Pain is worse with increased intrathecal pressure,
- Pain centralizes with movement
- Pain tends to be minimal to superficial structures on palpation
- May have neurological signs: DTR, sensory, muscle weakness

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DIFFERENTIAL DIAGNOSIS

Facet Joints

- Typically, over 50 years of age,
- Pain located lateral to the spine
- Pain does better with sitting and walking
- Pain does not centralize with movement
- Pain increased with lateral compression: Kemps test
- Sensitization of spinous process and overlying skin due to common innervation of the dorsal ramus of the spinal nerve

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DIFFERENTIAL DIAGNOSIS

Facet Joints

- Kemps Test (9), AKA extension-rotation test, or quadrant test
- Test is considered positive with pain on lumbar extension and rotation
- Suggested method: patient runs palm of hand down the back of their leg
- Note: test has low specificity, approximately 22%
  - Meaning, disc and SI pain are aggravated by this motion
- The value of this test is in its sensitivity for facet joint pain, reported to be 100%
- Meaning: if Kemps Test is negative, very high chance facet joints are not the cause of pain

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DIFFERENTIAL DIAGNOSIS

Facet Joints

- Sensitization of spinous process and overlying skin due to common innervation of the dorsal ramus of the spinal nerve
- a branch of a spinal nerve that emerges from the intervertebral foramen and travels backward. Along with facet joints, it innervates the deep muscles of the back, and the skin of the back

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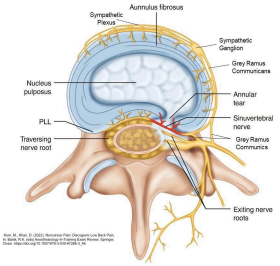
DIFFERENTIAL DIAGNOSIS

Facet Joints Vs Disc

- disc – minimal pain on palpation of superficial structures
- The back part of the spinal discs and the posterior longitudinal ligament are supplied by sinuvertebral nerves. The sides and back-sides of the discs receive nerve branches from nearby ventral primary rami and the grey rami communicantes. Other side areas of the discs are also supplied by branches from the rami communicantes.



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DIFFERENTIAL DIAGNOSIS

Sacroiliac Joints

- Pain is usually unilateral, below L5
  - Fortin finger sign
    - a clinical test involves the patient pointing to the area of pain with one finger, and a positive sign is when the point is within 1 cm of the posterior superior iliac spine (PSIS).
- Pain aggravated by static standing and walking
- Pain provoked when standing from sitting
- Will discuss more about SI joint in a moment

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DIFFERENTIAL DIAGNOSIS

Hip Pathology (8)

Osteonecrosis

Transient osteoporosis

- Osteonecrosis of the hip occurs in the pregnant state and should be consider in the differential diagnosis
- May present with non-specific groin pain, pelvic pain, or low back pain
- Has been postulated that higher adrenocortical activity during pregnancy combined with increased stresses may predispose the pregnant patient to osteonecrosis

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DIFFERENTIAL DIAGNOSIS

Hip Pathology (8)

- **Transient osteoporosis** of pregnancy is a rare disorder that occurs typically during the third trimester of pregnancy
- Typical presentation is hip pain with weight bearing, limited hip range of motion (ROM)
- MRI evidence of osteoporosis of the femoral head with preservation of the joint space.
- Early diagnostic imaging is important because persistent weight bearing can lead to stress or occult fracture of the hip or pelvis.
- POINT: evaluate the hip joint

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DIFFERENTIAL DIAGNOSIS

Hip Pathology

- SCOUR
- FABER
- Resisted Active SLR Stinchfield test
- Log Roll - Freiberg test
- FADIR

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DIFFERENTIAL DIAGNOSIS

Hip Pathology

SCOUR

- The patient is supine.
- The examiner passively flexes and adducts the patient's hip while applying axial compression through the femur, moving it in a circular motion (scanning across the acetabular rim)
- Positive test is reproduction of pain, apprehension, clicking, or catching, often in the groin.
- The test is highly sensitive but lacks specificity, meaning it is good for ruling out hip pathology but not necessarily diagnosing the *specific* cause

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DIFFERENTIAL DIAGNOSIS
Hip Pathology

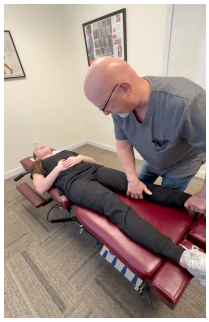
SCOUR

Labral Tears: Often indicated by clicking, catching, or a sharp pain in the groin.

Hip Osteoarthritis: Indicated by pain, stiffness, or a "leathery" end-feel.

Avascular Necrosis: Indicated by deep-seated pain and limited range of motion.

Capsular Tightness: Resistance or restriction felt during the arc of motion.



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DIFFERENTIAL DIAGNOSIS
Hip Pathology

FABER

- The patient lies in a supine position.
- The test leg is flexed, abducted, and externally rotated so the ankle rests on the contralateral (opposite) thigh, just above the knee
- The clinician stabilizes the opposite pelvis (anterior superior iliac spine - ASIS) and gently presses the knee of the tested leg down toward the table.
- A positive test is the reproduction of the patient's familiar pain.

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DIFFERENTIAL DIAGNOSIS
Hip Pathology

FABER

Pain in the Posterior Pelvis/SI Joint: Suggests sacroiliac joint dysfunction or sacroiliitis

Pain in the Groin/Hip: Suggests hip pathology, such as labral tears, impingement (FAI), or osteoarthritis

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DIFFERENTIAL DIAGNOSIS
Hip Pathology

Resisted Active SLR Stinchfield test

- The patient is in a supine (lying on their back) position with legs extended.
- The patient actively flexes (lifts) their hip to approximately 20-45 degrees while keeping the knee straight.
- The examiner applies a downward pressure on the leg, asking the patient to resist this force
- Pain in the hip or groin region during this resistance indicates a positive test.

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DIFFERENTIAL DIAGNOSIS
Hip Pathology

Resisted Active SLR Stinchfield test

Purpose: It isolates the hip joint to differentiate intra-articular hip pain (like osteoarthritis) from lumbar spine or extra-articular issues

Indications: It is often used when evaluating patients for hip pain, impingement, or labral tears

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DIFFERENTIAL DIAGNOSIS
Hip Pathology

Log Roll

- Patient lies supine with legs extended. The examiner rolls the femur internally and externally to its end range
- Pain (suggests hip pathology), clicking/popping (suggests labral tear), or increased range of motion compared to the opposite side (suggests ligamentous laxity)

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DIFFERENTIAL DIAGNOSIS
Hip Pathology

FADIR

- Flexion, Adduction, Internal Rotation
- The patient lies in a supine position
- The clinician flexes the patient's hip (brings the knee towards the chest) to approximately
- The hip is then passively adducted (moved across the body's midline) and internally rotated (the ankle is moved outward while the knee moves inward)
- The test is considered positive if this maneuver reproduces the patient's familiar anterior hip or groin pain.

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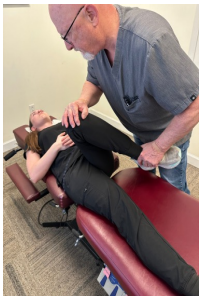
DIFFERENTIAL DIAGNOSIS
Hip Pathology

The test is used to reproduce symptoms associated with

Femoroacetabular Impingement (FAI): A condition where there is abnormal contact between the femoral head and the acetabulum,

Labral Tears: Injury or tears to the acetabular labrum, which is a cartilage structure that helps stabilize the hip joint.

Hip Osteoarthritis: Degeneration of the hip joint's cartilage



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DIFFERENTIAL DIAGNOSIS SUMMARY

Common musculoskeletal conditions resulting in back and pelvic pain:

- Lumbar Disc
- Facet Joints
- Sacroiliac Joints
- Hip Pathology

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CLINICAL PRESENTATION

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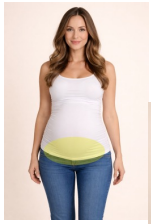
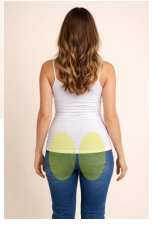
CLINICAL PRESENTATION (8)

- LBP & PGP associated with pregnancy are considered 2 separate entities.
- The current classification of PPGP is based on pain localization
- 5 subtypes
- Type 1 or "pelvic girdle syndrome" pain in anterior and posterior pelvic girdle, symphysis pubis and bilateral Sacroiliac joints





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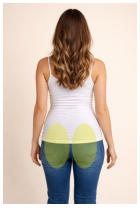
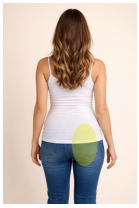
CLINICAL PRESENTATION (8)

- Type 2 or "double -sided sacroiliac syndrome" pain in posterior pelvic girdle and bilateral SI joints
- Type 3 - or "single sided sacroiliac syndrome" pain in posterior pelvic girdle and unilateral SI joint





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CLINICAL PRESENTATION (8)

- Type 4 - or symphysiolysis - pain in anterior pelvis and pubic symphysis

- Type 5 - "miscellaneous comprising inconsistent findings of the pelvic girdle

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PELVIC OBLIQUITY

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Key Sources

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(18) Damen L, Buyruk HM, Güler-Uysal F, Lotgering FK, Snijders CJ, Stam HJ. Pelvic pain during pregnancy is associated with asymmetric laxity of the sacroiliac joints. Acta Obstet Gynecol Scand. 2001 Nov;80(11):1019-24. doi: 10.1034/j.1600-0412.2001.801109.x. PMID: 11703199.

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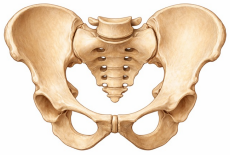
PLEVIC OBLIQUITY

Pelvic ring:

- The pelvis is composed of two innominate bones—ilium, ischium, and pubis
- joined anteriorly at the pubic symphysis and posteriorly to the sacrum at the sacroiliac joints
- It functions as a closed ring; dysfunction in any part impacts the entire structure
- and anterior or posterior components cannot be affected in isolation



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PLEVIC OBLIQUITY

Pelvic Mobility Changes in Pregnancy

A. Hormonal Influences

Relaxin and other pregnancy hormones increase ligamentous laxity.

- This leads to increased mobility of:
  - SIJs
  - Pubic symphysis
  - Associated ligamentous structures

B. Laxity and Pain

- Laxity is common and does not necessarily produce pain
- However, asymmetric laxity—particularly at the SIJs—has a strong association with pregnancy-related pelvic pain (PRPP).

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PLEVIC OBLIQUITY

Damen et al., 2001 – Asymmetric SIJ Laxity and Pelvic Pain

- Women with pregnancy-related pelvic pain exhibited significantly higher asymmetry in SIJ laxity compared to pain-free controls.
- The presence of asymmetric mobility (left vs right SIJ) correlated strongly with posterior pelvic pain.
- Asymmetry—not absolute hypermobility—was the critical factor.
- Clinical Implication: Assessment should focus on comparing mobility side-to-side rather than determining global laxity.

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PLEVIC OBLIQUITY
Morino et al., 2018 – Pelvic Alignment Risk Factors for SIJ Pain

- SIJ pain was significantly associated with:
  - Anterior pelvic tilt increases
  - Anterior displacement of the sacrum
  - Pelvic asymmetry in the frontal plane
  - Leg-length discrepancy functional patterns
- Women with SIJ pain consistently demonstrated altered pelvic alignment, especially asymmetry of the innominate
- These alignment changes increased mechanical load and stress on the SIJs.

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PLEVIC OBLIQUITY
Damen et al., 2002 – Asymmetric SIJ Laxity as a Prognostic Factor

- Asymmetric SIJ laxity during pregnancy strongly predicted:
  - Moderate to severe pelvic pain postpartum
  - Reduced functional capacity
  - Higher pain scores at 2–3 months postpartum
- Women with high SIJ laxity asymmetry were 3–4 timesmore likely to develop chronic or prolonged PGP.

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PLEVIC OBLIQUITY
Mechanisms Linking SIJ Asymmetry & Pelvic Pain

A. Hormonal Influences

Relaxin soften ligaments → generalized increased laxity.

With pre-existing asymmetry, this leads to **load imbalance** across the SIJs.

B. Altered Force Closure

Uneven SIJ stiffness reduces the joint's ability to resist shear.

Muscles involved in stabilizing the pelvis (gluteal, TLF, pelvic floor) may become dysfunctional.

C. Altered Form Closure

Anatomical misalignment changes the congruency of SIJ surfaces.

Leads to **micro-instability** and pain generation.

D. Motor Control Changes

Protective muscle guarding patterns may increase compressive forces and perpetuate symptoms.

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SIJ STABILITY

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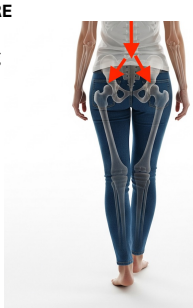
SI JOINT FORM AND FORCE CLOSURE

- Sacroiliac joint is a load transferring mechanism as we walk
- The stability of the sacroiliac joint should be a dynamic function
- A process that can increase or decrease as needed, based on the loading of the joint
- With pelvis and sacroiliac joints, if there was constant compression, motion would not be very likely



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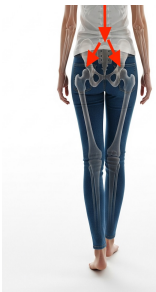
SI JOINT FORM AND FORCE CLOSURE

- The musculature allows us to change the compressive forces on the joint as necessary
- Sacroiliac joints stabilized by two different mechanisms: form closure and force closure



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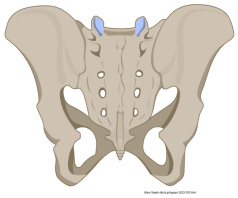
SI JOINT FORM AND FORCE CLOSURE

- Form closure refers to the stability of the sacroiliac joint based on pelvic anatomy
- The articular surfaces of the sacrum and ilium have multiple ridges and depressions that interlock, enhancing stability
- These grooves and ridges create high friction, protecting against shearing
- The bones form a keystone shape, with the sacrum's wider upper side wedged between the ilium



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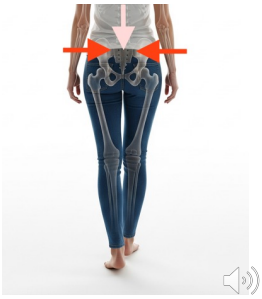
SI JOINT FORM AND FORCE CLOSURE

- Additional joint compression and stabilization of the SIJ are needed for mobility under vertical loads
- Force closure involves perpendicular forces to the sacroiliac joint, that vary based on loading conditions
- Muscles and ligamens contribute to force closure, which is crucial during activities like walking where unilateral leg loading creates shear forces



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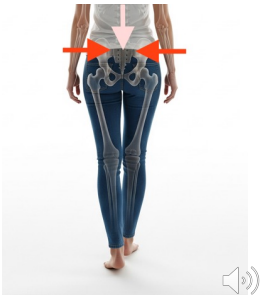
SI JOINT FORM AND FORCE CLOSURE

- This mechanism increases friction, enhancing form closure and facilitating self-bracing of the joint.
- Insufficient force closer can be the cause of many SIJ problems



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MYOFASCIAL SLINGS

Pregnancy & LBP Dr. Martin Schmaltz, DC, DIANM, CCSP

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MYOFASCIAL SLINGS & FORCE CLOSURE

- Muscle contraction creates a force that extends past the origin and insertion of the muscle
- This force is transmitted thru a structure called an anatomical sling, or myofascial sling, which is comprised of muscles, fascia and ligaments
- This transfer of force allows the muscle activity to produce force effects at a distant from the area of muscle contraction
- When forces from these slings are balanced, they provide optimal alignment of the joints as movement is produced in the pelvis

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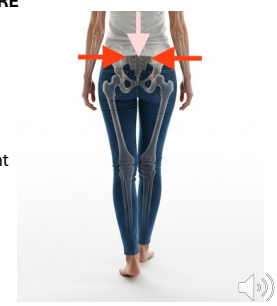
SI JOINT FORM AND FORCE CLOSURE

- The lumbo-pelvic complex plays a major role in load distribution and stability during movement
- Its primary role is to allow the efficient transfer of forces during complex movements and to prevent injury



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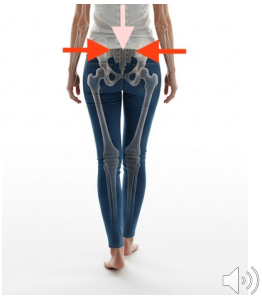
SI JOINT FORM AND FORCE CLOSURE

When it comes to providing this stabilization there are 4 primary anatomical or myofascial slings.

- Anterior Oblique Sling (AOS)
- Posterior Oblique Sling (POS)
- Deep Longitudinal Sling (DLS)
- Lateral Sling (LS)



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SI JOINT FORM AND FORCE CLOSURE

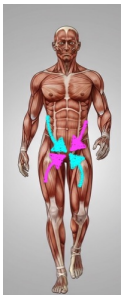
Anterior Oblique Sling (AOS)

Components

- External oblique
- Internal oblique
- Contralateral adductors
- Connected via the adductor–abdominal fascia

Function

- Acts like an **abdominal binder**
- Compresses the pelvic girdle
- Creates **force closure** at the symphysis pubis
- Works in coordination with the opposite AOS and other sling systems



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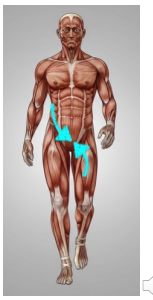
SI JOINT FORM AND FORCE CLOSURE

The AOS provides:

- Pelvic stability
- Rotational control
- Efficient force transfer
- Dynamic load management

It is both a **stabilizer and a rotator**.



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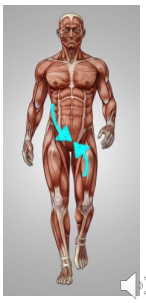
SI JOINT FORM AND FORCE CLOSURE

AOS During Walking (Gait)

During stance phase:

- Adductors + internal oblique + opposite external oblique co-contract
- Stabilize the body over the stance leg
- Rotate the pelvis forward
- Prepare the hip for heel strike
- Oblique muscles are active at initiation of stance phase
- Activation increases from walking → running



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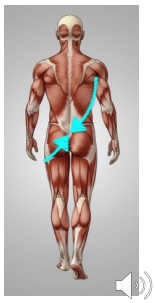
SI JOINT FORM AND FORCE CLOSURE

Posterior Oblique Sling (AOS)

Components:

- Latissimus dorsi (LD)
- Contralateral gluteus maximus (GM)
- Thoracolumbar fascia (TLF)
- This sling crosses at the sacro-lumbar junction.

The GM also connects into the iliotibial tract, linking the POS with the lateral sling.



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SI JOINT FORM AND FORCE CLOSURE

Primary Functions of the POS

- Stabilizes the sacroiliac joint (SIJ)
- Stabilizes the lumbar spine
- Controls trunk rotation
- Transfers force between upper and lower body
- Supports efficient gait

The POS assists movement **while stabilizing** the spine.

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SI JOINT FORM AND FORCE CLOSURE

POS During Gait (Single-Leg Stance)
Before Heel Strike:

- Hamstring prepares limb for weight bearing.
- Helps control anterior pelvic rotation.

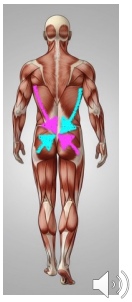
After Heel Strike:

- Hamstring activity decreases.
- Gluteus maximus takes over pelvic control.
- Contralateral latissimus dorsi controls arm swing (eccentric contraction).

During Propulsion:

GM + opposite LD contract together.
This increases tension in the TLF.

- Results in SIJ compression and lumbar stability.



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SI JOINT FORM AND FORCE CLOSURE

- The AOS & POS work like a muscle pair: antagonist and agonist relationship
- While one contracts, the other works to control the movement being produced

Example: Tennis Swing

AOS → produces rotation and acceleration.
POS → controls and decelerates movement (eccentric control).
Together they:
Maintain balance
Protect the lumbo-pelvic region
Stabilize during high-speed rotation

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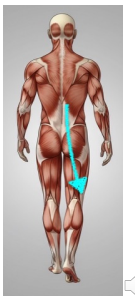
SI JOINT FORM AND FORCE CLOSURE

Deep Longitudinal Sling (DLS)

- DLS connects the erector spinae, multifidus, thoracolumbar facia, Sacrotuberous ligament and biceps femoris
- Allows for movement of flexion/extension, impacting stability of the pelvis
- Muscle contraction in this sling moves the SIJ into its stable closed packed position
- This closed packed position increases the tension in the ligaments, further reinforcing the stability



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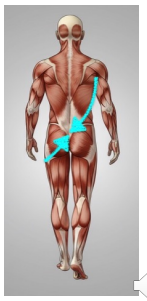
SI JOINT FORM AND FORCE CLOSURE

Deep Longitudinal Sling (DLS)

- The DLS is engaged throughout the day due to its inclusion of postural muscles, such as the erector spinae, and can increase its level of activation when necessary
- Such as returning upright after tying shoes → low-level activation
- Performing a deadlift → high tension, increased stability
- The DLS increases stability proportionally to load demand.



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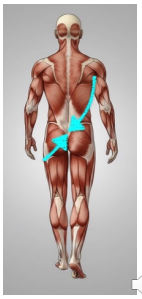
SI JOINT FORM AND FORCE CLOSURE

- Summary DLS
- The DLS connects spine to hamstrings through fascia and ligaments.
- It promotes sacral nutation and SIJ compression.
- It provides both extension movement and deep stability.
- It increases tension when load increases.
- It is critical for lifting, posture, and shear control.



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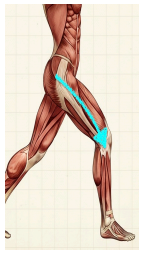
SI JOINT FORM AND FORCE CLOSURE

Lateral Sling (LS)

- LS made up of the gluteus medias & minimus, tensor fascia latae (TFL), iliotibial band (ITB)
- Starts at origin of gluteus medius ends at insertion of the ITB on the tibia
- Covers the lateral aspect of the hip and knee joint
- The LS is used in side-to-side stability
- Works to hold the pelvis level in single leg movements
- Pelvo-femoral stability of the hip in dynamic movements like gait lunges, stair climbing



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PREGNANCY EFFECT ON FORM & FORCE CLOSURE

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PREGNANCY EFFECT ON FORM AND FORCE CLOSURE

Pregnancy causes biomechanical and hormonal changes that can reduce:

- **Form closure** (bony stability)
- **Force closure** (muscle + ligament stability)

Key contributing factors:

- Altered posture and load-bearing
- Changes in ligament tension
- Altered muscle length
- Reduced muscle strength
- Poor muscular coordination

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PREGNANCY EFFECT ON FORM AND FORCE CLOSURE

Increased Anterior Load

- Average weight gain ≈ 24 LBS
- Load is carried anteriorly
- Center of mass shifts forward

Compensation:

- Increased lumbar lordosis
- Increased sacral nutation (flexion)
- Increased SIJ compression in standing
- Ultimately negative impact on form closure

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PREGNANCY EFFECT ON FORM AND FORCE CLOSURE

Effect on Form Closure

Short-term effect:

- Increased compression may enhance form closure.

Long-term effect:

- Excess compression can cause:
  - SIJ sclerosis
  - Osteitis condensans ilii
  - Local pain and tenderness

Pain reduces effective stability.

Most bony changes improve postpartum.

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PREGNANCY EFFECT ON FORM AND FORCE CLOSURE

Mechanical Stress on Ligaments

With increased nutation:

- Posterior SIJ ligaments are placed under prolonged tension.
- Repetitive stress may cause:
  - Micro-tearing
  - Reduced ligament efficiency
  - Compromised stability

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PREGNANCY EFFECT ON FORM AND FORCE CLOSURE

Effect on Muscular Slings

Prolonged nutation alters muscle length:

- **Muscles promoting nutation (may shorten):**
- **Muscles promoting counter-nutation (may lengthen):**

Altered muscle length → reduced force production.

Reduced force production → reduced force closure.

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PREGNANCY EFFECT ON FORM AND FORCE CLOSURE

- Pregnancy alters posture, ligaments, and muscle balance.
- Increased lordosis → increased nutation → increased SIJ compression.
- Hormones reduce ligament tension → reduced passive stability.
- Muscle imbalances reduce active force closure.

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SIJ EXAMINATION

Pregnancy & LBP Dr. Martin Schmaltz, DC, DIANM, CCIC

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SI JOINT PROVOCATION TESTS

- When it comes to evaluating the SIJ research has shown that there is not one gold standard provocation test to make the diagnosis.
- Gold standard is considered to be compared to fluoroscopically guided anesthetic SIJ block that relives pain
- It is recommended a group of test be performed
- There are 2 researched clusters of provocation test that have been shown to be reliable
  - Laslett's & Van der Wurff

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SI JOINT PROVOCATION TESTS

Laslett (10)

- Laslett's evidence demonstrates that a cluster of SIJ provocation tests improves diagnostic accuracy.

- Key diagnostic threshold:
- 3 or more positive provocation tests → highest accuracy
- Sensitivity up to 91% and specificity up to 78% when compared with fluoroscopically guided anesthetic SIJ block.

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SI JOINT PROVOCATION TESTS

Laslett (10)

- Distraction
- Compression
- Gaenslen's
- Sacral Thrust
- Thigh thrust - AKA Posterior Pelvic Pain Provocation Test (P4) will see in some literature regarding testing in pregnancy

- Recommends 3 or more positive to rule in SI joint as pain source

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SI JOINT PROVOCATION TESTS

Laslett (10)

Distraction

- Provokes anterior SIJ structures
- Patient supine.
- Doctor stand at patient's side.
- Place palms over ASIS bilaterally.
- Apply **posterolateral pressure** (cross-arm pressure preferred for even force).
- Hold at end-range for **30 seconds**.
- **Positive Test**
- Familiar unilateral SIJ pain reported in the gluteal/pelvic region

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SI JOINT PROVOCATION TESTS

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SI JOINT PROVOCATION TESTS

Laslett (10)

Compression

- Stresses posterior SI ligaments and compresses posterior pelvic ring.
- Patient: side-lying with painful side up (preferred).
- Doctor stand behind patient.
- Place hands over the lateral aspect of the iliac crest.
- Apply **downward, medial-directed pressure** toward the table. Maintain pressure for **30 seconds**.
- **Positive Test**
- Reproduction of the patient's familiar unilateral SIJ pain.

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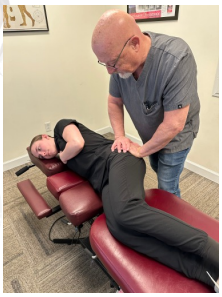
SI JOINT PROVOCATION TESTS



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SI JOINT PROVOCATION TESTS

Laslett (10)

Gaenslen's

- Stresses SIJ by producing torsion—anterior rotation on one side and posterior on the other
- Patient supine at table edge (classic) OR Side-lying modification
- Patient lies with one leg hanging off table; opposite hip flexed to chest.
- Doctor applies:
  - **Maximal hip flexion** to upper leg
  - **Downward pressure** to the hanging leg
  - Maintain simultaneous counter-rotation.
- Positive: Familiar SIJ pain on the side being stressed.

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SI JOINT PROVOCATION TESTS

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SI JOINT PROVOCATION TESTS

Laslett (10)

Sacral Thrust

- Direct provocation of the sacrum—shearing the SIJ anterior-to-posterior
- Patient is prone
- Doctor stand over patient.
- Place heel of hand at midline of sacrum (S2 level).
- Apply **anterior-directed force** vertically.
- Use oscillatory pressure or single firm thrust.
- Positive: Reproduction of **familiar SIJ pain**.

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SI JOINT PROVOCATION TESTS
Sacral Thrust

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SI JOINT PROVOCATION TESTS
Laslett (10)
Thigh thrust

- AKA Posterior Pelvic Pain Provocation Test (P4) in literature RE testing in pregnancy
- Produces a shear force across the SIJ—one of the **most sensitive** tests.
- Patient supine; hip flexed to 90°.
- Doctor stand on the side being tested.
- The hands wrap around the patient's flexed knee.
- Apply a **posterior shearing force** through the femur.
- Use graded oscillations then sustained pressure at end range.

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SI JOINT PROVOCATION TESTS
Laslett (10)
Thigh thrust

- Positive if reproduces **familiar** SIJ pain (not hip or lumbar pain).
- **Sensitivity:** Highest of all tests in Laslett's cluster
- **3 or more positive provocation tests → highest accuracy**

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SI JOINT PROVOCATION TESTS
Van der Wurff (16)
Van der Wurff and colleagues demonstrated that when multiple tests are positive, the likelihood that the SIJ is the primary pain generator increases.

- Distraction
- Compression
- Thigh Thrust
- Gaenslen's
- FABER Test

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SI JOINT PROVOCATION TESTS
FABER (Flexion, Abduction, External Rotation) Test

- Patient supine, the patient's hip is *F*lexed, *AB*ducted and *E*xternally *R*otated so that the heel rests on the opposite kneecap.
- Pain may be experienced in the inguinal region, which suggests hip joint pathology. Pain may also be experienced in the back or SIJ, suggesting SIJ dysfunction.
- Also known as the figure-4 test and Patrick's maneuver.

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SI JOINT PROVOCATION TESTS
Van der Wurff (16)

- According to Van der Wurff's recommendations:
- **Three or more positive tests → High likelihood of SIJ dysfunction** as the primary pain generator.
- **Pain must be familiar**, meaning it reproduces the patient's typical symptomatic experience rather than causing generalized discomfort.
- This threshold has been shown to provide better sensitivity and specificity than any single test alone.
- Importantly, negative results across the cluster make SIJ-mediated pain less probable
- Guiding toward alternative sources such as lumbar facet joints or hip pathology.

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OTHER SIJ TESTING

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SI JOINT PROVOCATION TESTS

Active Straight Leg Rasing Test ASLR (2)

- patient supine with both legs extended on the table
- The patient raises one leg at a time to 30° of hip flexion without flexing the knee.
- Positive with pain in the back with the leg raised, or describes a heaviness or difficulty in performing
- Challenges pelvic stability – force closure - Force closure deficit
- Compensations include twisting the trunk, holding beath, pressing down on opposite leg

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SI JOINT PROVOCATION TESTS

Active SLR

- Second part of test, posterior compression is applied and the patient is then asked to actively perform a straight leg raise
- If there is less pain upon compression or greater ease in motion this is considered a positive provocative test

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SI JOINT PROVOCATION TESTS

Trendelenburg's

- The patient stands on the affected leg in a single-leg stance for up to 30 seconds.
- The provider stands behind the patient at the hip level and places their hands on the iliac crests on either side of the pelvis, observing if it stays level during the single-leg stance.
- Repeat the test on the opposite side.
- Positive sign is when the pelvis drops on the unaffected side or contralateral side
- Weakness gluteus medius & minimus

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SI JOINT TESTS

Long Dorsal Ligament Test

- The patient lies prone and will be examined for tenderness on bilateral palpation of the LDL directly under the caudal part of the posterior superior iliac spine.
- The pain will be scored by examiner on a 4-point scale :
- 0 : no pain
  1 : mild pain
  2 : moderate pain
  3 : unbearable pain
- The sum score can be situated between 0-6 because the scores on both sides are added.

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SI JOINT TESTS

The Long dorsal sacral ligament test in pregnant women

- The patient lies on her side with slight flexion in both hip and knee joints. If the pain caused by the palpation remains for more than 5 seconds after the examiner removes his hand, it is considered as pain. It is considered as tenderness when the pain disappears within 5 seconds.

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PROGNOSIS

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PROGNOSIS (11)

"The purpose of this study was to describe the clinical outcomes of patients with pregnancy-related lumbopelvic pain (PRLP) treated according to a diagnosis-based clinical decision rule."

3 classifications based on pain location

- Lumbar pain (LP)
- Posterior pelvic pain (PPP)
- Both LP & PPP

Patients seen for average of 6.8 visits

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PROGNOSIS (11)

Results

End of treatment:

- 73% rated improvement as excellent or good
- 51% experienced clinically significant improvement in disability
- 67% experienced clinically significant improvement in pain

11 month follow up:

- 85.5% rated improvement as excellent or good
- 73% experienced clinically significant improvement in disability
- 82% experienced clinically significant improvement in pain.

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PROGNOSIS (11)

Conclusion

~~Location of pain appears to affect outcome in short term, but lesser degree in long term~~

- Patients with LP had most favorable outcomes
- Patients with PPP seems to fair more poorly than those with LP
- Patients with both LP and PPP had less favorable outcomes than those with pain in one area
- Disability was noted as less for those with pain in one location
- Disability was greater in those with LP & PPP

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PROGNOSIS (1)

"To develop a clinical prediction rule (CPR) for identifying postpartum women with low back pain (LBP) and/or pelvic girdle pain (PGP) whose functional disability scores improve with a high-velocity thrust technique (HVTT) …"

Findings predictive of positive results

- Pain that did not extend below the knee
- Symmetrical (negative) PSIS test in seated position
- Positive seated flexion test
- Positive prone bent knee test

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PROGNOSIS (1)

- Positive prone bent knee test

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PROGNOSIS (1)

Patients with all 4 findings probability of 93% success

Patients with:
- Pain that did not extend below the knee
- Symmetrical (negative) PSIS test in seated position

The next most likely successful outcome

Individually:
- Symmetrical (negative) PSIS test in seated position, most predictive of success

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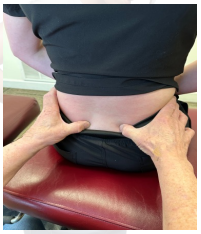
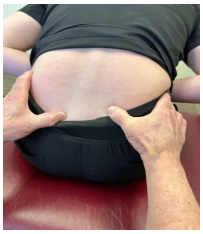
PROGNOSIS (1)

- Symmetrical (negative) PSIS test in seated position
- Positive seated flexion test





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PROGNOSIS (1)

Indicators of unsuccessful outcome
- Age greater than 35
- VAS best score greater than 3/10 in last 24 hours
- Negative prone knee bend test

Summery

Presence of 2 of 4 criterial for success = 92% chance success

Presence of 2 of 3 failure = 75% chance of failure

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MANAGEMENT

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MANAGEMENT

Goals of Treatment With Manual Therapy
- Reduce pain
- Segmental analgesic effect (adjustments)
- Improve sensorimotor integration
- Activate descending inhibitions
- Alter global muscle recruitment
- Improve segmental muscles recruitment/stabilization

- Adjusting the SIJ, we can effect proprioceptive representation, sensory awareness, central neurological effects and load transfer

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MANAGEMENT

Study by George Et al (16)
- Compared 2 groups of women with LBP/PGP
- One treated standard obstetric care (STOB)
- Second Multimodal (MOM) and STOB

All baseline 24-28 weeks gestation, examination consisting of:

3 subjective questionnaires
- Numeric rating scale (NRS) - 0-10
- Quebec task force disability questionnaire (QDQ) assess the impact of pain
- Personal Pain History (PPH) - detailed previous course and features of pain complaints

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MANAGEMENT

Study by George Et al (16)

4 physical tests

- Straight Leg Raise (SLR)
- Posterior PP Provocation Test – Thigh Thrust
- Active Straight Leg Raise
- Long Dorsal Ligament Tests

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MANAGEMENT

Study by George Et al (16)

Results at 33 weeks gestation

- The MOM group noted a significant reduction all 7 pain indices
- The STOB only 1 pain indices had a significant reduction
- The STOB group reported an increase in 5 pain indices: QDQ, SLR, Active SLR and PPH.
- Additionally, the MOM group reported significantly less trouble sleeping compared to the STOB

Conclusion *"A multimodal approach to low back and pelvic pain in mid pregnancy benefits patients more than standard obstetric care."*

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MANAGEMENT

Acupuncture (12)

- Objective to see if one week of continuous auricular acupuncture could reduce LBP and PPP associated with pregnancy.
- Participants divided into 3 groups:
  - Acupuncture group
  - Sham acupuncture group
  - Control group

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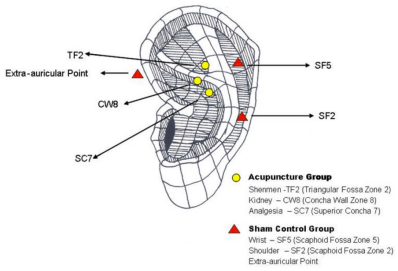
MANAGEMENT

Acupuncture (12)



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MANAGEMENT

Acupuncture (12)

At a 7 day follow-up,

- about 80% of the participants in the *acupuncture* group experienced a clinically significant reduction in pain
- compared to 56% of participants in the *sham acupuncture* group
- 36% of participants in the *control* group.

- **Conclusion— "**One week of continuous auricular acupuncture decreases the pain and disability experienced by women with pregnancy related low back and posterior pelvic pain."

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MANAGEMENT

Other home interventions

- Use wedge pillow to support stomach while side lying
- Use pillow between the knees while side lying
- Avoid hyperlordosis while standing
- Do not sit or stand for long periods of time
- Use a small foot stool for one foot while sitting or standing
- Sit on an exercise ball and simulate a walking movements with the legs (proprioception/muscle activation)
- Pelvic tilt exercises: supine, knees flexed, rock pelvis between anterior and posterior position

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SUMMERY

- Low back and posterior pelvic pain is common during pregnancy
- Causes can be: Mechanical, Circulatory, Psychosocial and Hormonal
- Relaxin itself is not associated with pain levels
  - However, it affects the mechanics of joints, especially the SIJ
    - Asymmetrical Ligament Laxity is indicator of PGP and post partum pain
- One risk factor is diagnosis of hypermobility
- 5 subtypes of clinical presentation

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SUMMERY

- Common differential diagnosis: hip, lumbar disc, facet or SIJ
- SIJ stability is a common issue
  - Form and Force closure
- 5 SIJ provocation tests, 3 or more positive to rule in SIJ as source of pain
- Prognosis: Patients with LP had most favorable outcomes
- Goals of manual therapy
- Multimodal care better than standard obstetric care
- Acupuncture can be favorable
- Home care and exercises

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CONTACT

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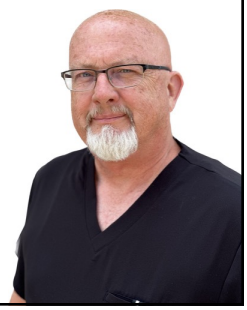

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EDUCATION

Diplomate International Academy of Neuromusculoskeletal Medicine (DIANM)

- **Board Certified Chiropractic Orthopedics**

Certified Chiropractic Insurance Consultant – Licensed in Missouri

- Peer Review Certification, *Identifying causality, proper diagnosis coding, effects of co-morbidities, appropriate treatment protocols and documentation along with the determination of maximum medical improvement or static and stationary.* Texas Chiropractic College
- Independent Medical Examination Certification, *documenting the essentials of causal relation, apportionment and permanent impairment, appropriate physical examination techniques, documentation and report writing*. Texas Chiropractic College

100 Hour Traditional Acupuncture Program – National University Of Health Sciences

DOT Medical Examiner Training - New York Chiropractic College
Completed post doctorate program in DOT Certified Medical Examiner Training

Chiropractic Sports Physician Program - Los Angeles Chiropractic College
Post doctorate program in sports injury and physical fitness

100 Hour Physiotherapy Certification - Brenau University (Atlanta GA)

Erhardt X-ray Seminars, Leading to Certification 100 Hours in X-ray reading/interpretation - Dr. Russell Erhardt, DCBAR

Life Chiropractic College
Graduated Cum Laude with Doctor of Chiropractic degree

RELATED PROFESSIONAL EXPERIENCE

September 2025 – Present — Logan University School of Chiropractic — Chesterfield MO
Adjunct Faulty
Overseeing student interns in patient care including examination, diagnosis and treatment plans.

September 2025 – Present — Crosby Chiropractic Centre — St Peters MO
Chiropractic Orthopedist
Examination and management of patient care programs

May 2013 – May 2025 — Dr. Martin Schmaltz, DC, LLC — Hazelwood MO
Owner
Skillset includes leadership, patient education, staff development, team player, business development, detailed documentation.

- August 2023 – May 2025 — Spinal Rehabilitation Center — St Louis MO
- **St Louis Division Director (contracted)**
  - Worked with owners to open 2 personal injury clinics in the St Louis area
  - Trained staff and doctors
  - Development of attorney relations

March 2021 – Present — DC Power Hours — Moberly MO
Continuing Education Instructor

As Scheduled — Northeastern College of Health Sciences — Seneca NY
Continuing Education Instructor

November 2017 – 2021 — Auto Injury Solutions — Nationwide
Personal Injury Utilization Reviews

October 2011 – May 2013 — Crosby Chiropractic Centre — St Peters MO
Associate Doctor

RELEVANT TRAINING & QUALIFICATIONS

Dizziness, Balance & Posture, *An in-depth study of the neurology of balance and postural control, including the vestibular system and proprioceptive capacity of the cervical spine. Including examination and diagnosis of associated dysfunction resulting in sensorimotor disturbances.* Advanced Clinical Training and Post-doctrinal program in Chiropractic Orthopedics and Neuromuscular Medicine. University of Bridgeport, Health Sciences Postgraduate Education Department.

Pain In The Frame, *Understand the latest concepts in pain science including nociceptive inputs impact on the central pain neuromatrix, peripheral sensitization, and central sensitization resulting in chronic pain syndromes.* Advanced Clinical Training and Post-doctrinal program in Chiropractic Orthopedics and Neuromuscular Medicine. University of Bridgeport, Health Sciences Postgraduate Education Department.

Neurodiagnostics, Imaging Protocols and Pathology of the Trauma Patient, *An in-depth understanding of the protocols in triaging and reporting the clinical findings of the trauma patient. Maintaining ethical relationships with the medical-legal community*. Texas Chiropractic College or PACE Recognized by The Federation of Chiropractic Licensing Boards, Academy of Chiropractic Post-Doctoral Division, Long Island, NY, 2017

Diagnostics, Risk Factors, Clinical Presentation and Triaging the Trauma Patient*, An extensive understanding of the injured with clinically coordinating the history, physical findings and when to integrate neurodiagnostics. An understanding on how to utilize emergency room records in creating an accurate diagnosis and the significance of "risk factors" in spinal injury.* Cleveland University - Kansas City, Academy of Chiropractic Post-Doctoral Division, Long Island, NY, 2020

Crash Dynamics and Its Relationship to Causality, *An extensive understanding of the physics involved in the transference of energy from the bullet car to the target car. This includes G's of force, newtons, gravity, energy, skid marks, crumple zones, spring factors, event data recorder and the graphing of the movement of the vehicle before, during and after the crash. Determining the clinical correlation of forces and bodily injury.* Cleveland University - Kansas City, Academy of Chiropractic Post-Doctoral Division, Long Island, NY, 2020

MRI, Bone Scan and X-Ray Protocols, Physiology and Indications for the Trauma Patient, *MRI interpretation, physiology, history and clinical indications, bone scan interpretation, physiology and clinical indications, x-ray clinical indications for the trauma patient.* Cleveland University - Kansas City, Academy of Chiropractic Post-Doctoral Division,

Neurodiagnostic Testing Protocols, Physiology and Indications for the Trauma Patient, *Electromyography (EMG), Nerve Conduction Velocity (NCV), Somato Sensory Evoked Potential (SSEP), Visual Evoked Potential (VEP), Brain Stem Auditory Evoked Potential (BAER) and Visual-Electronystagmosgraphy (V-ENG) interpretation, protocols and clinical indications for the trauma patient.* Cleveland University - Kansas City, Academy of Chiropractic Post-Doctoral Division, Long Island, NY, 2020

Documentation and Reporting for the Trauma Victim*, Understanding the necessity for accurate documentation and diagnosis utilizing the ICD-9 and the CPT to accurately describe the injury through diagnosis. Understanding and utilizing state regulations on reimbursement issues pertaining to healthcare.* Cleveland University - Kansas City, Academy of Chiropractic Post-Doctoral Division, Long Island, NY, 2020

Documenting Clinically Correlated Bodily Injury to Causality, *Understanding the necessity for accurate documentation, diagnosis and clinical correlation to the injury when reporting injuries in the medical-legal community. Documenting the kinesiopathology, myopathology, neuropathology, and pathophysiology in both a functional and structural paradigm.* Cleveland University - Kansas City, Academy of Chiropractic Post-Doctoral Division, Long Island, NY,

Personal Injury Documentation, Coding, and Case Management, *Understanding the importance of personal injury documentation, correct coding of injuries and co-morbidities as well as proper case management and rehabilitation.* Logan University, St Louis MO. 2020