The Hip-Spine Connection: Exploring the Relationship of the Lumbosacral Spine and the Hip Joint for Comprehensive Evaluation and Treatment.

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Conflict of Interest Disclosure
The instructors of this course disclose the following conflict of interests:
Dr. Hal D. Martin is a consultant for Smith and Nephew

Learning Objectives:

- Identify the key anatomical and biomechanical relationships of the hip joint and lumbosacral spine.
- Apply current evidence of anatomical and biomechanical relationships of the hip joint and lumbosacral spine to the evaluation, differential diagnosis, and management of "Hip-Spine Dysfunction".
- Prioritize a systematic examination that can be used to evaluate a patient with "Hip-Spine Dysfunction".

- Understand indications for conservative and surgical management of “Hip-Spine Dysfunction”.
- Implement therapeutic interventions based on current evidence and contemporary biomechanical principles to reduce pain and improve function for patients with “Hip-Spine Dysfunction”.

Defining “Hip-Spine Dysfunction”

• Interaction between the lumbopelvic complex and the hip joint[1]

• Pathology of the hip joint can clinically impact the lumbosacral spine and vice versa[1]

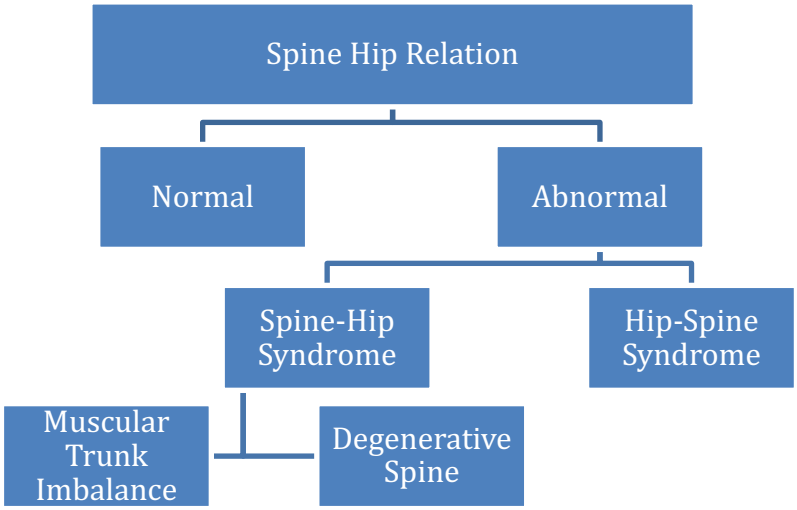
- Patients with coexisting hip arthrosis and lumbar spine disorders[2]
- 32.5% of patients who undergo lumbar surgery have radiographic evidence of hip pathology[3]
- 72.7% of patients with hip osteoarthritis have low back pain[4]

Abnormal spine-hip relation

- When one of these anatomical structures becomes dysfunctional, a clinically deleterious compensatory mechanism is often initiated by the other
- Two types:

  • hip-spine syndrome: dysfunction of the hip joint leads to lumbosacral pathology

  •spine-hip syndrome: dysfunction of the lumbosacral spine that leads to hip joint pathology



Structural anatomy of the hip and lumbosacral spine

	Hip Joint	Lumbosacral Spine
Layer 1 **Osseo-Chondral**	• Femoral Morphology • Acetabular Morphology • Articular cartilage degeneration	• Sacroiliac dysfunction • Lumbar Facet Joints
Layer 2 **Inert Layer**	• Capsular laxity • Labral pathology	• Disc lesions • Lumbar instability • Sacroiliac instability
Layer 3 **Contractile**	• Hip Flexion contractures • Gluteus medius pathology • Hip Adductor weakness	• Latissimus Dorsi/Thoracolumbar fascia • Erector Spinae • Quadratus Lumborum • Abdominals

Layer 4 **Neuro-Mechanical**		• Deep gluteal syndrome • Movement Impairments	• Nerve Entrapments • Dural Tension • Directional preference

Acetabular Version

- Normal acetabular anteversion angle = 20º
- Excessive anteversion = anterior Instability (i.e. external rotation)
- Excessive Retroversion = Anterior Impingement

dynamic measures that describe body position
• sacral slope – horizonal & sacral plate (Green)

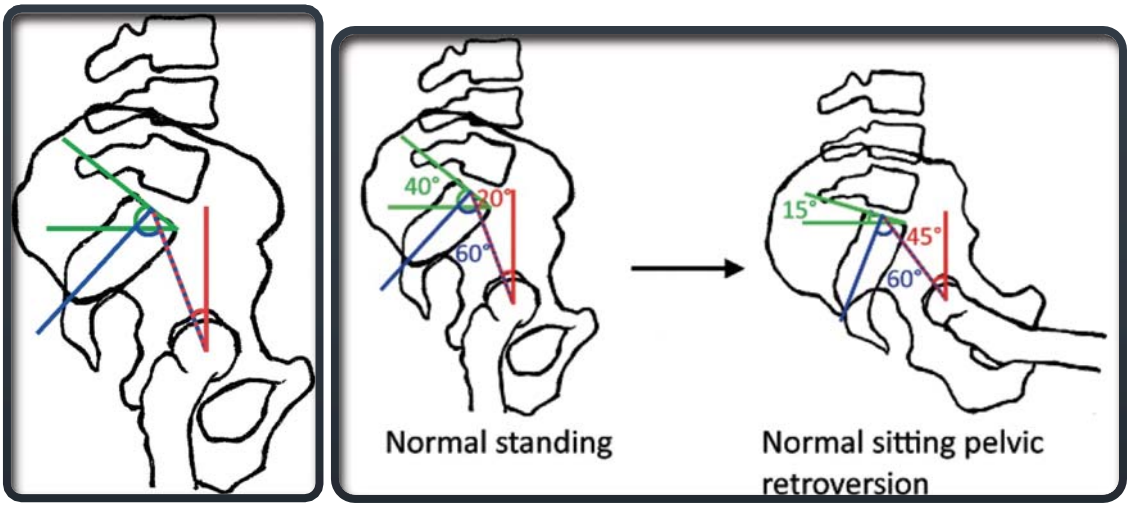
- Increases with Anterior Tilt (Becomes more vertical)

- Decreases with Posterior Tilt (Becomes more horizontal)

• pelvic tilt – vertical & midpoint of sacral plate (Red)

-Increases with Posterior Tilt

-Decreases with Anterior Tilt



Static measures that describe position

- pelvic incidence - midpoint of sacral plate & width in anterior to posterior direction (Blue)
    - sacral slope + pelvic tilt
    - Does not change
    - mean 52°; range 35°-85°

• A healthy hip requires a healthy functioning Lumbopelvic Complex

Classification of Spine-hip syndrome: "hip users (overusers)"

- the lumbopelvic complex **won't** move

    • poor active movement patterns

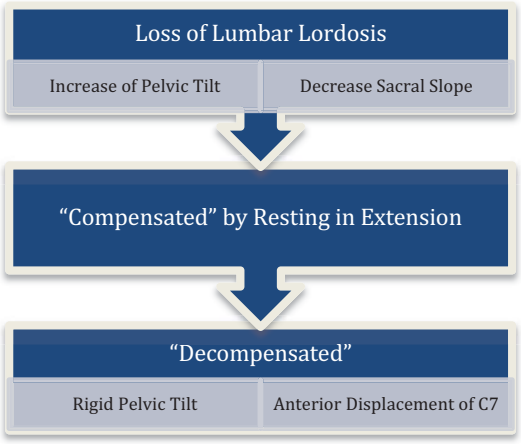
    • Muscular trunk imbalance

        - May or May not be hypomobile in the Lumbopelvic Spine
        - Unable to Posterior Pelvic Tilt
        - Functional Acetabular Retroversion
        - "Lower Cross Syndrome"
            - Tight "Facilitated" hip flexors
            - Increased Erector Spinae activity
            - Poor abdominal activity
    - Hip Compensates with greater Movement

- Patients with FAI tend to have greater anterior tilt with squatting
- Subjects with FAI have less squat depth[5]

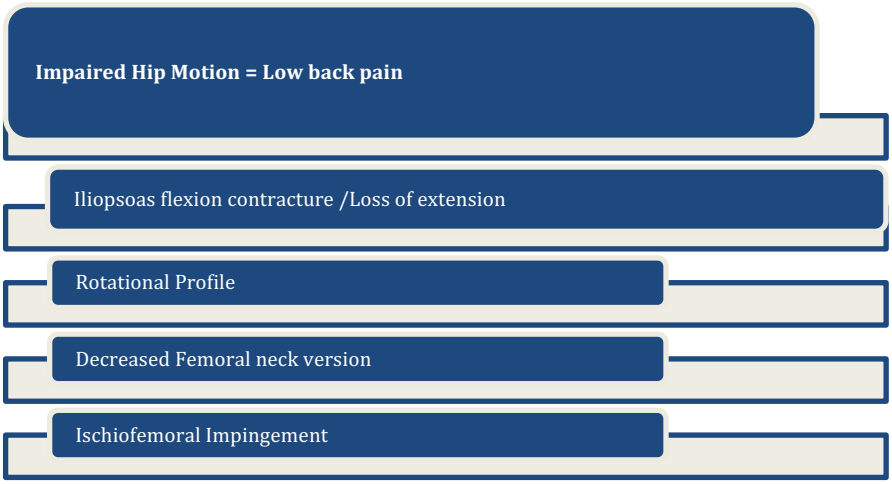
- spine-hip syndrome: "**can't** move" • the ageing spine

  - Stiff spine (low pelvic incidence)
    • degenerative disc disease
    • osteoporotic vertebral collapse
  - Loss of lordosis
  - Increased posterior pelvic tilt (sacral slope decreases)
    - Anterior undercoverage
    - Posterior overcoverage
      - Posterior impingement
        - 26%-40% of patients undergoing THR
  - Lumbopelvic complex is hypomobile
  - Progressive spinal degeneration



  - posterior impingement
  - anterior rim loading
  - post - total hip

Hip-Spine Syndrome



Hip ROM Impacts Low Back Pain

- Iliopsoas contracture & intradiscal pressure
  - In a normal iliopsoas condition, intradiscal pressure at L5-S1

    Increases beyond 15° of extension

  - While in a contracted condition intradiscal pressure increases

    At 0° & increases with further extension.

  - Intradiscal pressures at l5-s1 are increased with a contracted
  - Iliopsoas at 0° & increases with further extension.
  - Intradiscal pressures decrease with iliopsoas tendon release

- Abnormal Rotational Profile
  - patients with low back pain have less total rotational ROM[6]
  - patients with low back pain have greater external hip rotation > internal hip rotation[7]
  - Correlation of low back pain with decreased internal rotation and FABERE's distance. [8]

- Decreased femoral version

• positive craig's test
• mri confirming femoral version

- ≤ 5° males
- ≤ 10° females

- effects on gait
  - No Hip extension
  - Excessive anterior pelvic tilt
  - Increased hip flexion

- Ischiofemoral impingement
  • contact of ischium to lesser trochanter

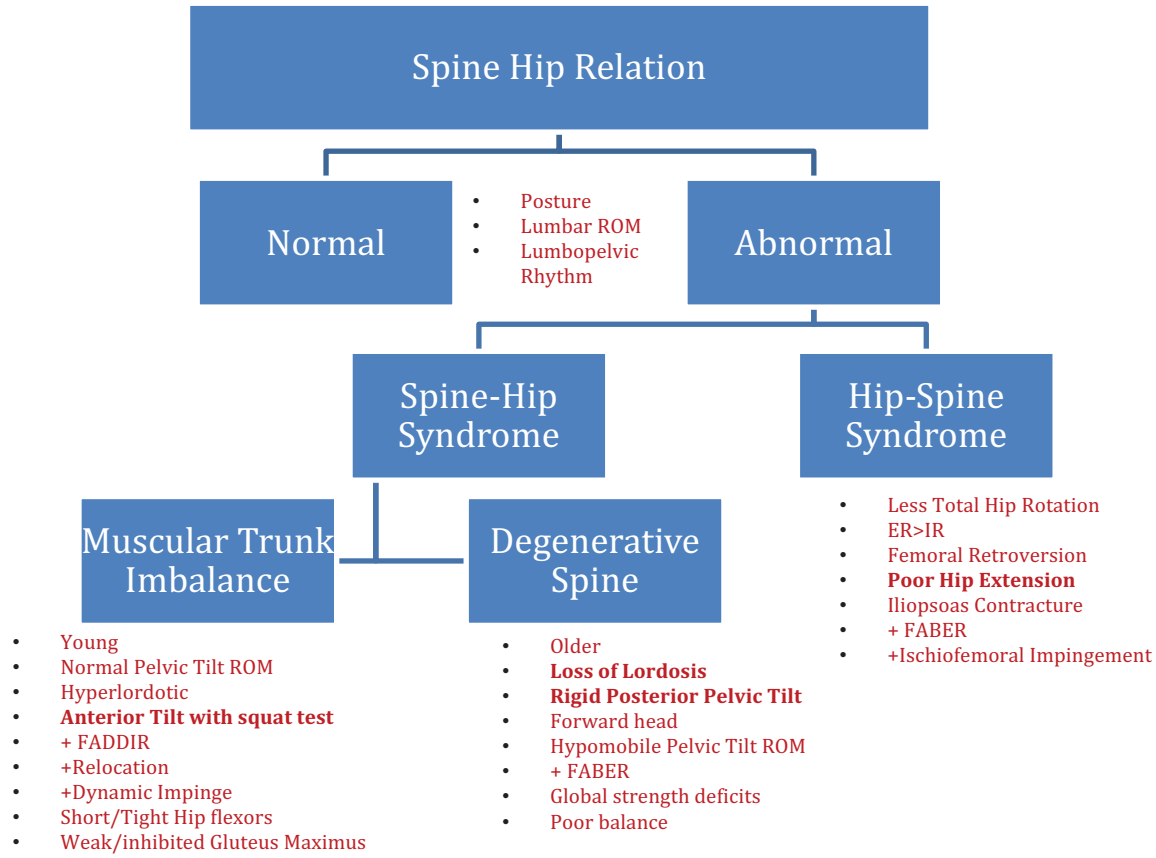
  - impinged structures

    • quadratus femoris
    • sciatic nerve
    • iliopsoas tendon/bursa
    • common hamstring tendon

  • pain with lateral rotation, extension, adduction

  - Femoral Version (FV) & Lesser Trochanter Femoral Neck angle (LTFN) are significantly higher in patients with symptomatic ischiofemoral impingement.
  - Lesser Trochanter Version (LTV) is not increased in patients with symptomatic ischiofemoral impingement.

A Systematic Approach to Evaluation of "Hip-Spine Dysfunction"



Hip-spine connection

- Significant correlation between cam type impingement (alpha angle and anterior femoral neck offset) and spinal osteoarthritis[9]
- Patients with low back pain and positive exam findings for hip pathology have greater pain and impaired function[10]
- The sacral slope and lumbar lordosis were greater in patients with hip dysplasia versus those without hip dysplasia.
- Patients with hip dysplasia might show lumbar hyperlordosis to rotate the pelvis anteriorly, increasing the anterosuperior acetabular coverage.[11]

Surgical Treatment Options for "Hip-Spine Dysfunction"

- Surgical options
- Determining who is appropriate for surgery

- Appropriate diagnostic imaging
- Surgical outcomes

Outcomes

- After THR, a relief of both hip and low back pain and a change in spinopelvic parameters is observed[12]
- Both Low Back Pain and spinal function were improved following total hip arthroplasty[13]
- Patients that receive spinal surgery first have poor outcomes following total hip arthroplasty[14]
- Addressing the hip pathology first may be associated with improved functional outcome[15]

Classification Based Treatment

•Trunk/Core Weakness
•Hip/Lower Extremity Weakness
•Lumbosacral Spine Hypomobility
•Hip Hypomobility

Key Findings: Trunk/Core Weakness[16]

- Trunk flexor strength
- Double-leg lowering
- Trunk Extensors
    - Timed prone lumbar extension
- Lateral Abdominals
    - Timed side plank with knees flexed

Interventions: Trunk/Core Weakness

- Pelvic Tilt Progression
- Four-point Kneeling: Arm and Leg Lift
- Good Morning
- Side Plank
- Prone Plank

Key Findings: Hip/Lower Extremity Weakness

- Manual Muscle Tests
- Single Leg Bridge Test
- Single Leg Stance
- Single Leg Squat Test
- Step Down Test

Interventions: Hip/Lower Extremity Weakness

- Step Progression
- Monster Walks
    - Forward backwards and sideways
- Standing Abduction
- Clamshell
- Standing Sport Cord Rotation

Electromyographic Maximum Volitional Isometric Contraction (%MVIC) for Gluteus Maximus and Gluteus Medius Therapeutic Rehabilitation Exercises

Gluteus Medius		**Gluteus Maximus**	
Exercise	%MVIC	Exercise	%MVIC
Side plank abduction with dominant leg on bottom	103%	Front plank with hip extension	106%
Side plank abduction with dominant leg on top	89%	Lateral step up	90%
Single limb squat	82%	Gluteal squeeze	81%
Side lying hip abduction	81%	Rotational single leg squat	78%
Clamshell (hip clam)	77%	Standing hip abduction with band at ankle	73%
Front plank with hip extension	75%	Side plank abduction with dominant leg on top	73%

Side bridge	74%	Side plank abduction with dominant leg on bottom	71%
Single leg supine bridge (on stable surface)	73%	Single limb squat	71%

Key Findings: Lumbopelvic Hypomobility

- ROM
- Segmental Mobility

Interventions: Lumbopelvic Hypomobility

- Joint Mobilization
- Stretching

Key findings: Hip Hypomobility

- ROM
- Flexibility
    - Modified Thomas
- Joint Mobility
    - Distraction

Interventions: Hip Hypomobility

- Stretching
- Joint Mobilization
    - NWB
    - WB with Movement

References

1. Rivière C, Lazic S, Dagneaux L, Van Der Straeten C, Cobb J, Muirhead-Allwood S. Spine–hip relations in patients with hip osteoarthritis. *EFORT open reviews.* 2018;3(2):39-44.
2. Offierski C, MacNab I. Hip-spine syndrome. *Spine.* 1983;8(3):316-321.

3. Lee BH, Moon SH, Lee HM, Kim TH, Lee SJ. Prevalence of hip pathology in patients over age 50 with spinal conditions requiring surgery. *Indian journal of orthopaedics.* 2012;46(3):291.
4. French H, O'Donnell B, O'Connell P, Cuddy V. The prevalence and clinical signs and symptoms of low back pain in people with hip osteoarthritis: a cross sectional study. *Osteoarthritis and Cartilage.* 2014;22:S398-S399.
5. Lamontagne M, Kennedy MJ, Beaule PE. The effect of cam FAI on hip and pelvic motion during maximum squat. *Clinical orthopaedics and related research.* 2009;467(3):645-650.
6. Van Dillen LR, Bloom NJ, Gombatto SP, Susco TM. Hip rotation range of motion in people with and without low back pain who participate in rotation-related sports. *Physical Therapy in Sport.* 2008;9(2):72-81.
7. Mellin G. Correlations of hip mobility with degree of back pain and lumbar spinal mobility in chronic low-back pain patients. *Spine.* 1988;13(6):668-670.
8. Vad VB, Bhat AL, Basrai D, Gebeh A, Aspergren DD, Andrews JR. Low back pain in professional golfers: the role of associated hip and low back range-of-motion deficits. *The American journal of sports medicine.* 2004;32(2):494-497.
9. Gebhart JJ, Weinberg DS, Conry KT, Morris WZ, Sasala LM, Liu RW. Hip-spine syndrome: Is there an association between markers for cam deformity and osteoarthritis of the lumbar spine? *Arthroscopy: The Journal of Arthroscopic & Related Surgery.* 2016;32(11):2243-2248.
10. Prather H, Cheng A, Steger-May K, Maheshwari V, Van Dillen L. Hip and lumbar spine physical examination findings in people presenting with low back pain, with or without lower extremity pain. *journal of orthopaedic & sports physical therapy.* 2017;47(3):163-172.
11. Fukushima K, Miyagi M, Inoue G, et al. Relationship between spinal sagittal alignment and acetabular coverage: a patient-matched control study. *Archives of orthopaedic and trauma surgery.* 2018;138(11):1495-1499.
12. Piazzolla A, Solarino G, Bizzoca D, et al. Spinopelvic parameter changes and low back pain improvement due to femoral neck anteversion in patients with severe unilateral primary hip osteoarthritis undergoing total hip replacement. *European Spine Journal.* 2018;27(1):125-134.
13. Ben-Galim P, Ben-Galim T, Rand N, et al. Hip-spine syndrome: the effect of total hip replacement surgery on low back pain in severe osteoarthritis of the hip. *Spine.* 2007;32(19):2099-2102.
14. Eneqvist T, Bülow E, Nemes S, et al. Patients with a previous total hip replacement experience less reduction of back pain following lumbar back surgery. *Journal of Orthopaedic Research®.* 2018.
15. Grammatopoulos G, Gofton W, Jibri Z, et al. 2018 Frank Stinchfield Award: Spinopelvic Hypermobility Is Associated With an Inferior Outcome After THA

Examining the Effect of Spinal Arthrodesis. *Clinical Orthopaedics and Related Research®.* 2018.
16. Delitto A, George S, Van Dillen L. et al. Low Back Pain: Clinical Practice Guidelines Linked to the International Classification of Functioning, Disability, and Health from the Orthopaedic Section of the American Physical Therapy Association. *J Orthop Sports Phys Ther.* 2012;42(4):A1-A57.

Other works of interest

1. Wong TK, Lee RY. Effects of low back pain on the relationship between the movements of the lumbar spine and hip. Human movement science. 2004 Jun 1;23(1):21-34.

2. Mun F, Suh SW, Park HJ, Choi A. Kinematic relationship between rotation of lumbar spine and hip joints during golf swing in professional golfers. Biomedical engineering online. 2015 Dec;14(1):41.

3. Alqhtani RS, Jones MD, Theobald PS, Williams JM. Investigating the contribution of the upper and lower lumbar spine, relative to hip motion, in everyday tasks. Manual therapy. 2016 Feb 1;21:268-73.

4. Buckland AJ, Miyamoto R, Patel RD, Slover J, Razi AE. Differentiating Hip Pathology From Lumbar Spine Pathology: Key Points of Evaluation and Management. JAAOS-Journal of the American Academy of Orthopaedic Surgeons. 2017 Feb 1;25(2):e23-34.

5. Prather H, Cheng A, Steger-May K, Maheshwari V, Van Dillen L. Hip and lumbar spine physical examination findings in people presenting with low back pain, with or without lower extremity pain. journal of orthopaedic & sports physical therapy. 2017 Mar;47(3):163-72.

6. An VV, Sivakumar BS, Levy YD, Pierrepont J, Bruce WJ. Practical implications of the lumbar spine and its function on total hip arthroplasty. Journal of Spine Surgery. 2016 Dec;2(4):334.

7. Douglas P. Beall, Hal D. Martin, Douglas N. Mintzd, Justin Q. Lye. Richard F. Costelloa, Brett A. Bralyc, Farida Yoosefianf. Anatomic and structural evaluation of the hip: a cross-sectional imaging technique combining anatomic and biomechanical evaluations. Clinical Imaging 32 (2008) 372–381

8. Ellison, J. B., Rose, S. J., & Sahrmann, S. a. (1990). Patterns of hip rotation range of motion: a comparison between healthy subjects and patients with low back pain. *Physical Therapy*, *70*(9), 537–41.

9. L.R. Van Dillen. Hip Rotation range of motions in people with or without low back pain who participate in rotation-related sports. Physical Therapy in Sport 9 (2008) 72–81 73.

10. Mellin G. .Correlations of hip mobility with degree of back pain and lumbar spinal mobility in chronic low-back pain patients. Spine. 1988; 13(6): 668-70.

11. Vad, V. B. (2004). Low Back Pain in Professional Golfers: The Role of Associated Hip and Low Back Range-of-Motion Deficits. *American Journal of Sports Medicine*, *32*(2), 494–497.

12. Martin HD, Khoury A, Schröder R, Palmer IJ. Ischiofemoral impingement and hamstring syndrome as causes of posterior hip pain: Where do we go next?. Clinics in sports medicine. 2016 Jul 1;35(3):469-86.

13. Gómez-Hoyos J, Khoury A, Schröder R, Johnson E, Palmer IJ, Martin HD. The Hip-Spine Effect: A Biomechanical Study of Ischiofemoral Impingement Effect on Lumbar Facet Joints. Arthroscopy. 2017 Jan 1;33(1):101-7.