Clinical Practice Guideline: Surgical Sequencing and Management of Hip-Spine and Knee-Spine Syndromes

Arvind J. Vatkar[1], Sachin Kale[2], Sumedha Shinde[3], Ashok Shyam[4]

Abstract

Hip-spine and knee-spine syndromes are complex, multisegmental degenerative conditions where spinal, pelvic, hip, and knee pathologies interact biomechanically. Effective management requires a holistic approach, not isolated joint treatment. Key compensatory changes, including loss of lumbar lordosis, sagittal imbalance, and lower-limb contractures (pelvic retroversion, hip extension, knee flexion), impact posture, pain, and function. Spinopelvic parameters, like pelvic incidence, are crucial for alignment, surgical planning, and outcomes in total joint arthroplasty. Clinical assessment must distinguish true joint pathology from referred spinal pain to prevent misdiagnosis and inappropriate surgical sequencing. Current evidence favors a global, alignment-focused strategy, involving careful preoperative imaging, recognition of deformities, and multidisciplinary planning to optimize the timing of arthroplasty and spine surgery. Restoring lower-limb mechanics often relieves low back pain and improves overall balance, mobility, and quality of life.

Keywords: Hip-spine syndrome, Knee-spine syndrome, Spinopelvic alignment, Surgical sequencing, Arthroplasty-first approach

Introduction: The Clinical Paradigm of Multi-Segmental Degeneration

In the modern landscape of spinopelvic bio-architecture, treating degenerative joint disease in isolation is an antiquated and incomplete strategy. Patients frequently present with multi-segmental degeneration across the kinetic chain, manifesting as Hip-Spine Syndrome (HSS) and Knee-Spine Syndrome (KSS). This clinical entity synthesizes the pioneering work of Offierski and MacNab (Hip-Spine) and Tsuji et al. (Knee-Spine), recognizing that the spine, pelvis, and lower extremities are anatomically and functionally inseparable.These syndromes represent a failure of the "chain of balance," where disorders of the lumbar spine and lower extremities overlap [1].

To achieve optimal surgical outcomes, the practitioner must evaluate the patient as a biomechanical whole, acknowledging that a deformity in one segment inevitably forces compensatory shifts in others.

The prevalence of concurrent low back pain (LBP) in patients seeking lower-limb arthroplasty is remarkably high. Diagnostic accuracy is paramount to avoid the clinical failure of treating the wrong driver of disability. (Table 1)

Epidemiological Prevalence of LBP in OA Populations

Clinical Pearl: The high incidence of concurrent LBP underscores the necessity of a global radiographic and clinical screening of the spine in all patients scheduled for joint replacement [1].

Biomechanical Framework: The "Cone of Economy" and Compensatory Mechanisms

The maintenance of an ergonomic upright posture is governed by the "Cone of Economy." In a physiological state, the body aligns the head, spine, pelvis, and lower extremities to maintain balance as an inverted pendulum with minimal energy expenditure. When the center of gravity remains within this narrow cone, stability is high. However, as degenerative changes expand the cone, the metabolic cost of standing increases, eventually necessitating supportive devices to mitigate fall risk [2].

[1]Department of Orthopaedics, MGM Medical College, Navi Mumbai, Maharashtra, India.
[2]Department of Orthopaedics, Dr. D.Y. Patil School of Medicine, Navi Mumbai, Maharashtra, India.
[3]Department of Immuno Haematology and Blood Transfusion, Dr. D.Y. Patil School of Medicine, Navi Mumbai, Maharashtra, India.
[4]Department of Orthopaedics, Sancheti Institute for Orthopaedics and Rehabilitation, Pune, Maharashtra, India.

Address of Correspondence
Dr. Sachin Kale,
Department of Orthopaedics, Dr. D.Y. Patil School of Medicine, Navi Mumbai, Maharashtra, India.
E-mail: sachinkale@gmail.com

Submitted Date: 04-04 2026, Review Date: 12-04-2026, Accepted Date: 15-04-2026 & Published Date: 10-05-2026

Journal of Clinical Orthopaedics | Available on www.jcorth.com | DOI: https://doi.org/10.13107/jcorth.2026.v11.i01.820

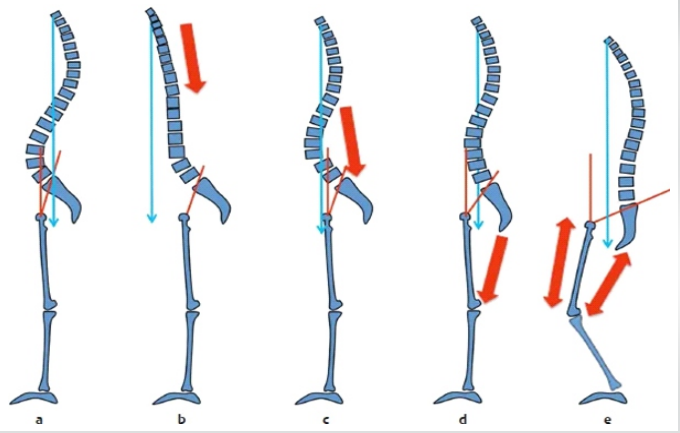

Figure 1: Sequential compensatory deformities in spine, hip and knee to compensate spinal kyphosis.

Table 1: Prevalence of concurrent low back pain in hip and knee osteoarthritis.

Cohort	Prevalence of Concurrent LBP	Typical LBP Severity (VAS)
Hip Osteoarthritis (OA)	55.88%	Moderate to Severe (Avg. 6.84)
Knee Osteoarthritis (OA)	62.22%	Moderate to Very Severe (Avg. 6.39)

When the spine loses its sagittal profile—specifically the loss of lumbar lordosis (LL)—the body triggers a predictable, sequential chain of compensatory mechanisms: Figure 1.

1. Spinal Kyphosis: Forward truncal shift, increasing the Sagittal Vertical Axis (SVA).
2. Pelvic Retroversion: Posterior tilting to pull the center of gravity back over the base of support.
3. Hip Extension and Knee Flexion: Utilization of lower limb "crouch" to maintain uprightness.
4. Ankle Dorsiflexion: The final link in the kinetic chain to prevent forward tipping [3].

The "So What?" Factor: Impact on Quality of Life These mechanisms are energy-intensive. An increased SVA correlates directly with a decline in health-related Quality of Life (QOL) due to chronic muscle fatigue and restricted activity. Furthermore, the shift in the center of gravity impairs the patient's ability to react to environmental perturbations, significantly increasing fall risk. In the aging population, these falls lead to high-morbidity fractures, making global alignment a critical survival factor rather than a mere comfort metric [4].

The Pelvic Incidence (PI) and Spinopelvic Parameters

Pelvic Incidence (PI) is the fundamental anatomical bridge between the spine and the hip. Defined as the angle between a line perpendicular to the sacral plate and a line connecting the midpoint of the sacrum to the center of the femoral head, PI dictates the capacity for lumbar lordosis and sagittal balance.

While PI was historically viewed as a "fixed parameter," recent bio-architectural insights reveal a dynamic reality in the aging skeleton. SIJ instability and degeneration allow for nutation (sacral tilting) and counternutation, meaning PI measurements are posture-dependent in older cohorts [5].

"The assumption of a fixed PI is challenged by aging-related sacroiliac joint (SIJ) instability. Postural changes in the PI have been reported to decrease from flexion to extension. Studies indicate that 12.5% of patients undergoing lumbar spine surgery exhibit a PI change of more than 10 degrees on the operating table compared to their standing radiographic profile"[5].

Increased PI correlates with higher risks of spondylosis, stenosis, and disc herniation. Crucially, PI dictates acetabular cup orientation; failure to account for these parameters during Total Hip Arthroplasty (THA) leads to improper positioning, edge loading, and post-surgical dislocation.

The Critical Role of Spinal and Pelvic Examination

The lumbar spine acts as the primary regulator in the compensatory mechanism between the head and the lower extremities. Because the spine, pelvis, and hips are linked, the clinician must maintain a high index of suspicion for "misdiagnosed hip-spine syndrome." A frequent diagnostic pitfall is the failure to recognize that thigh, hip, or knee pain may be the clinical triad of L3 nerve root radiculopathy rather than local joint osteoarthritis.

Conversely, severe hip OA often forces a forward-bending trunk, which triggers secondary low back pain (LBP) through compensatory muscle strain. To differentiate these pathologies, the "Pendulum Test" serves as a critical diagnostic differentiator. By identifying true hip pathology through specific physical

Table 2- Significant resolution of low back pain after hip and knee replacement.

Measurement	Total Hip Arthroplasty (THA)	Total Knee Arthroplasty (TKA)
Preoperative VAS (LBP)	6.84	6.39
4 Months Postoperative VAS	2.58	4.79
12 Months Postoperative VAS	2.53	4.04
Patients with LBP Improvement	**79%**	**50%**

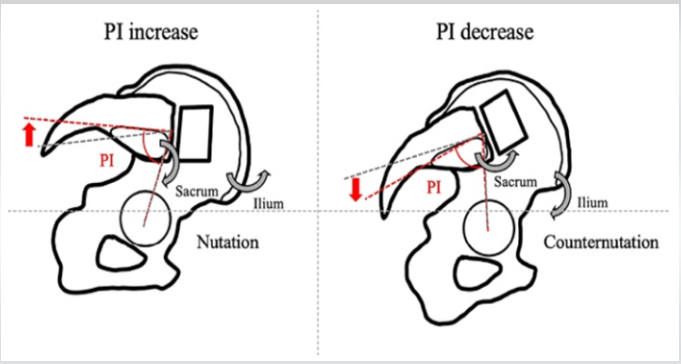

Figure 2: Nutation and counternutation and its effect on pelvic incidence[6].

maneuvers, the surgeon can distinguish between joint-originated pain and referred lumbar radiculopathy, preventing unnecessary or incorrectly targeted surgeries. These clinical observations, however, require validation through objective metrics and advanced radiographic parameters to formulate a precise surgical roadmap [7].

Evidence-Based Rationale for the "Arthroplasty-First" Approach

In the presence of concurrent joint and spinal degeneration, the clinician should prioritize the "Arthroplasty-First" approach. Restoring lower-limb mechanics often facilitates a spontaneous resolution of LBP, which may render spinal intervention unnecessary. (Table 2)

Clinical Outcomes: LBP Resolution Post-Arthroplasty [1]

Evaluating the Proximity Effect and Resolution Barriers THA yields a 79% resolution rate, significantly higher than TKA's 50%. This "proximity effect" occurs because the hip joint is anatomically closer to the lumbopelvic complex. Conversely, KSS resolution is often hindered by knee flexion contractures and leg length discrepancies that cause persistent trunk imbalance. Notably, while LBP improves, there is no obvious correlation between LBP resolution and the correction of pelvic obliquity or joint pain; LBP resolution mechanisms remain complex and independent of these specific parameters [8].

Multidisciplinary Clinical Assessment and Risk Mitigation

Interdisciplinary communication between surgeons and therapists is mandatory to prevent "mishit" surgeries. Diagnostic clarity requires categorizing the patient according to the Offierski and MacNab framework with associated clinical directives:

- Simple HSS: Primary involvement of one area with minor changes in the other.

o Directive: Proceed with the symptomatic joint; monitor the secondary site.

- Secondary HSS: Spinal symptoms result from compensatory posture (e.g., hyperlordosis from hip flexion).

o Directive: Prioritize the hip to resolve the spinal driver.

- Complex HSS: Significant, independent degeneration in both segments.

o Directive: Simultaneous multidisciplinary planning; prioritize the joint to stabilize kinematics.

- Misdiagnosed HSS: Symptoms are incorrectly attributed (e.g., L3 radiculopathy mistaken for hip OA).

o Directive: Mandate a Pendulum Test or L3 radiculopathy screening to confirm the true pathology [9].

Surgical Sequencing Risks Sequencing is critical: spinal fusion preceding THA—especially those involving pelvic or sacral fixation—"locks" the pelvis. This loss of pelvic kinematics prevents posterior tilt during sitting, drastically increasing the risk of posterior hip dislocation. Joint restoration should occur while pelvic mobility is preserved [10].

Conclusion and Procedural Recommendations

This guideline mandates a holistic mandate: the knee-hip-spine is an interconnected system. Clinical success depends on the restoration of global sagittal alignment and the stabilization of the kinetic chain.

Practitioner Checklist for HSS/KSS Management:

- Prioritize Arthroplasty: Perform THA or TKA before spinal surgery to leverage spontaneous LBP resolution.
- Global Alignment Mandate: Conduct 3D sagittal assessments (SVA, LL, PI) preoperatively for all complex cases.
- Monitor Independent Markers: Monitor pelvic obliquity for coronal balance assessment; however, do not use it as a proxy for LBP resolution.
- Mandate Postural PI Assessment: Evaluate PI in multiple positions for elderly patients to account for SIJ instability (nutation/counternutation) before spinal planning.
- Identify Contractures: Screen for knee flexion contractures in KSS, as these are primary drivers of trunk imbalance and lower LBP resolution.

Final Statement: The clinical priority remains lower-limb restoration. While the link between LBP resolution and pelvic obliquity is not clear, the stabilization of the kinetic chain through arthroplasty is the most effective first step in improving global balance, restoring the "Cone of Economy," and preventing falls in the aging population.

Declaration of patient consent: The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given his consent for his images and other clinical information to be reported in the Journal. The patient understands that his name and initials will not be published, and due efforts will be made to conceal his identity, but anonymity cannot be guaranteed.

Conflict of Interest: NIL; **Source of Support:** NIL

References

1. ?1. Kechagias VA, Grivas TB. Hip-Spine and Knee-Spine Syndrome: Is Low Back Pain Improved After Total Hip and Knee Arthroplasty? Cureus [Internet]. 2024 Apr;16(4):e57765. Available from: http://dx.doi.org/10.7759/cureus.57765

2. Hasegawa K, Dubousset JF. -Historical Perspective and Proof of Concept. Spine Surg Relat Res [Internet]. 2022 Apr 20;6(4):337–49. Available from:

http://dx.doi.org/10.22603/ssrr.2022-0038

3. Haddas R, Kosztowski T, Mar D, Boah A, Lieberman IH. Balance effort, Cone of Economy, and dynamic compensatory mechanisms in common degenerative spinal pathologies. Gait Posture [Internet]. 2021 Sep;89:67–73. Available from: http://dx.doi.org/10.1016/j.gaitpost.2021.04.038

4. Hsu MC, Soong C, Yeh TJ, Chen HY. Development of quantitative instrumentation for cone of economy analysis: bridging radiographic and clinical measures. Spine J [Internet]. 2025 Aug;25(8):1821–9. Available from:

http://dx.doi.org/10.1016/j.spinee.2025.03.005

5. Chu ECP, Wong AYL. Change in Pelvic Incidence Associated With Sacroiliac Joint Dysfunction: A Case Report. J Med Cases [Internet]. 2022 Jan;13(1):31–5. Available from:

http://dx.doi.org/10.14740/jmc3816

6. Nishizawa M, Ishikawa Y, Nakashima S, Zhongyuan S, Rosenfeld MG, Onishi Y, et al. Lower lumbar spine significantly affects the dynamics of pelvic incidence after corrective surgery for adult spinal deformity. Eur Spine J [Internet]. 2025 Jul;34(7):2890–9. Available from:

http://dx.doi.org/10.1007/s00586-025-09024-3

7. Buckland AJ, Miyamoto R, Patel RD, Slover J, Razi AE. Differentiating Hip Pathology From Lumbar Spine Pathology: Key Points of Evaluation and Management. J Am Acad Orthop Surg [Internet]. 2017 Feb;25(2):e23–34. Available from: http://dx.doi.org/10.5435/JAAOS-D-15-00740

8. Kouyoumdjian P. How the hip-spine relationship influences total hip arthroplasty. Orthop Traumatol Surg Res [Internet]. 2024 Feb;110(1S):103773. Available from:

http://dx.doi.org/10.1016/j.otsr.2023.103773

9. Yoshimoto H, Sato S, Masuda T, Kanno T, Shundo M, Hyakumachi T, et al. Spinopelvic alignment in patients with osteoarthrosis of the hip: a radiographic comparison to patients with low back pain. Spine (Phila Pa 1976) [Internet]. 2005 Jul 15;30(14):1650–7. Available from:

http://dx.doi.org/10.1097/01.brs.0000169446.69758.fa

10. Zhang SE, Anatone AJ, Figgie MP, Long WJ, Della Valle AG, Lee GC. Spine or Hip First? Outcomes in Patients Undergoing Sequential Lumbar Spine or Hip Surgery. J Arthroplasty [Internet]. 2023 Jul;38(7S):S114–8.e2. Available from: http://dx.doi.org/10.1016/j.arth.2023.04.030

Conflict of Interest: NIL
Source of Support: NIL

How to Cite this Article

Vatkar AJ, Kale S, Shinde S, Shyam A. Clinical Practice Guideline: Surgical Sequencing and Management of Hip-Spine and Knee-Spine Syndromes. Journal of Clinical Orthopaedics. January-June 2026;11(1):01-04.