

# Knee-Spine Syndrome, a Common Presentation in Elderly Patients Who Are Candidate for Knee Arthroplasty: Educational Corner

Alireza Moharrami<sup>1</sup>, Mohammad Mirahmadi Eraghi<sup>2</sup>, Shahabaldin Beheshti Fard<sup>3</sup>, Ali Asadifar<sup>4</sup>, Ali Salehi<sup>5</sup>, Sadulla Sharifpour<sup>6</sup>, Seyed Mohammad Javad Mortazavi<sup>1,7,\*</sup>

<sup>1</sup> Orthopedic Surgeon, Joint Reconstruction Research Center, Tehran University of Medical Sciences, Tehran, Iran

<sup>2</sup> Student of Medicine, Student Research Committee, School of Medicine, Islamic Azad University, Qeshm International Branch, Qeshm, Iran; Joint Reconstruction Research Center, Tehran University of Medical Sciences, Tehran, Iran

<sup>3</sup> Resident, Department of Orthopedics, Imam Khomeini Hospital Complex, Tehran University of Medical Sciences, Tehran, Iran

<sup>4</sup> Resident, Department of Radiology, Afzalipour Faculty of Medicine, Kerman University of Medical Sciences, Kerman, Iran

<sup>5</sup> Resident, Department of Radiology, Imam Hosein Hospital, Shahid Beheshti University of Medical Sciences, Tehran, Iran

<sup>6</sup> Orthopedic Surgeon, Imam Khomeini Hospital Complex, Tehran University of Medical Sciences, Tehran, Iran

<sup>7</sup> Orthopedic Hip and Knee Surgeon, Joint Reconstruction Research Center, Tehran University of Medical Sciences, Tehran, Iran

\*Corresponding author: Seyed Mohammad Javad Mortazavi; Joint Reconstruction Research Center, Tehran University of Medical Sciences, Tehran, Iran. Tel: +98-2161192767  
Email: smjmort@yahoo.com

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## Abstract

Low back pain (LBP) is a significant issue in both clinical and public health settings, resulting in high healthcare and social costs. While knee joint pain is more prevalent than hip joint pain, standing posture is influenced not only by spinal alignment but also by hip and knee joint alignment. The knee and spine are interconnected anatomically, and degenerative changes in one area could often cause discomfort in the entire axis, leading to what is known as "knee-spine syndrome". LBP is a common condition associated with knee pain and can significantly affect the results of total knee arthroplasty (TKA). Surgeons need to consider knee-spine syndrome before any surgical intervention in patients with knee or back pain and explain it to the patients before the surgery.

**Keywords:** Low Back Pain; Knee; Spine; Syndrome; Patellofemoral Pain Syndrome

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## Background

Low back pain (LBP) is a significant issue in both clinical and public health settings, resulting in high healthcare and social costs (1). Despite its prevalence, the root cause of LBP remains unclear. However, several clinical studies have identified a potential association between spinal alignment and LBP (2, 3). Knee joint pain is also a prevalent clinical problem, particularly among the elderly population.

Officerski and MacNab's research established a correlation between hip and spine pain, known as hip-spine syndrome, which is not uncommon among older individuals (4). While knee joint pain is more prevalent than hip joint pain, standing posture is influenced not only by spinal alignment but also by hip and knee joint alignment. Therefore, it is crucial to determine the pathological correlation between spinal alignment and knee symptoms in the elderly population (5, 6). Measuring lumbar lordosis (LL) and sacral inclination is essential for making clinical decisions, as maintaining normal lumbar lordotic curve and sacral inclination is associated with preventing spinal disorders (6). With the increasing use of spinal instrumentation, studies on spinal alignment have become increasingly important (7). Measuring LL and sacral inclination in asymptomatic subjects and comparing the results with those from a symptomatic group of patients with LBP is beneficial (7). In this study, we explored the correlation between knee and spine pain, as well as the impact of surgical intervention on this relationship.

### Knee-Spine Syndrome

The alignment of the spine, pelvis, and lower

extremities and the muscle strength of the lower extremities and body trunk contribute to the ergonomic upright body posture maintenance. The loss of LL leads to pelvic retroversion, spinal kyphosis, knee flexion, hip extension, and ankle dorsiflexion (8).

Several investigations regarding sagittal spinal alignment have primarily focused on above-hip components, not considering the knee joint. "Knee-spine syndrome" was described earlier; however, the underlying mechanism has not been remarked on (9). The causation of degenerative spine conditions and the correlation between LL and knee extension is called "knee-spine syndrome" (10).

In a cohort study of 30 young men, two motion-controlled knee braces were applied to simulate knee settings of 0°, 15°, and 30° flexion. While the mean values of pelvic tilt (PT) and sacral slope (SS) scarcely modified, the corresponding femoropelvic angle (FPA) and LL meaningfully decreased at 15° and 30° compared with the parameters at the 0° knee setting. Femoral tilt angle was found to be strongly correlated with FPA ( $r = -0.83$ ,  $P < 0.01$ ). The knee flexion decreased LL without a meaningful change of pelvic posture in the non-affected population (9).

Tsuji et al. evaluated the correlation between sacral inclination, LL, and patellofemoral (PF) joint pain in a cohort of 399 elderly patients aged 50-85. Thirty-nine percent of all patients were excluded due to definite osteoarthritis (OA) at the femorotibial joints. 16% of the patients complained of PF joint grinding pain, and 58% presented with LBP lasting at least 3 months. Sixteen percent of the patients demonstrated knee flexion over



standing. There was a meaningful variance in sacral inclination between the patients representing PF joint grinding pain and lack thereof ( $P < 0.01$ ). Sacral inclination was almost  $5^\circ$  less in patients with knee flexion. The author speculated that this phenomenon resulted from changes in lumbar alignment, highlighting "knee-spine syndrome" (11).

#### ***Knee or Spine, Which Should Be Addressed First?:***

Lumbar spine surgeries and total knee arthroplasty (TKA) were found to affect the outcomes of each other mutually. Evidence highlighting the best therapeutic choice for patients suffering from equally symptomatic conditions remains insufficient.

Goodman et al. designed five scenarios of progressive, degenerative knee, and concurrent lumbar spinal disorders to survey the therapeutic choice of orthopedic surgeons and rationale. The knee disorders varied to be inclusive of OA with valgus deformity, OA with varus deformity, OA without deformity, bilateral OA with windswept deformities, and rheumatoid arthritis (RA) with severe flexion contracture. On the other hand, the spinal condition was consistently degenerative lumbar spinal stenosis. The estimated rate of knee arthroplasty surgeons suggesting "TKA first" meaningfully diverged among before-mentioned scenarios: 79%, 29%, 7%, 81%, and 55%, respectively ( $P < 0.001$ ), followed by a similar pattern recommended by spine surgeons. For subjects representing concurrent lumbar spinal disorders and degenerative knee, knee deformity sub-types and severity levels affected the preference of management order in both groups. Windswept knee deformities and severe valgus deformity could yield the decision towards TKA first (12).

In a prospective cohort of 200 patients investigating the percentage of patients undergoing bilateral total knee replacement (TKR) with concurrent lumbar spine disorders, Londhe et al. evaluated whether TKR would alleviate lumbar spine symptoms in two-year follow-up. All bilateral TKRs were accompanied by radiographic lumbar spine degenerative pathology; 60% of cases represented moderate-to-severe clinical manifestations of lumbar spondylosis, of which degenerative spondylolisthesis, as well as degenerative lumbar spondylosis and lumbar spinal canal stenosis, was noted in 6% and 54% of such cases, respectively. Among the 120 cases presented with lumbar spine disorders, 90% represented symptom reliefs; the Oswestry Disability Index (ODI) score pre-operatively fell in a range from  $42.5 \pm 4.1\%$  to  $15.6 \pm 2.3\%$  score postoperatively ( $P < 0.001$ ). Among the 12 cases representing no improvement, one patient declined any intervention, one underwent surgery, and 10 were scheduled to receive percutaneous procedures for their lumbar spine channel pathology with favorable results; symptomatic lumbar spine disorders also accompanied a considerable number of bilateral TKR. Patients representing non-severe lumbar spine degenerative clinical manifestations were more likely to be symptom-free after TKA surgeries (13).

***Spinopelvic Changes Following TKA:*** Several studies have evaluated the correlation between patient-reported outcome measures and spinopelvic alignment following TKA, which may improve our knowledge of any correlation between perceived knee joint function or satisfaction and global sagittal spinal deformity in patients undergoing TKA (14).

Kitagawa et al. evaluated changes in sagittal global balance, spinopelvic alignment, and LBP after knee flexion

contracture removal using TKA. A limited knee extension level was found to correlate with lower LL. Pre-operatively, 66% of all patients presented with LBP and mostly demonstrated anteriorly shifted global imbalance related to a lower knee flexion contracture and LL, and the patients representing severe knee joint flexion contracture demonstrated more forwardly shifted global balance with lower LL and backward PT. Postoperatively, one-third of patients experienced lower LBP, and flexion contractures of the knee were eliminated in most cases. Conversely, the sagittal vertical axis increased more and was associated with increased SS and a slight decrease in PT. No significant discrepancies were identified between preoperative pelvic incidence (PI) values and LL compared with postoperative time. Moreover, no significant differences were found in post-surgical values of spinopelvic parameters in patients representing relieved LBP compared with the lack thereof. Though one-third of patients revealed lower LBP following TKA, the sagittal global imbalance was not recovered after removing the knee joint flexion contracture (15).

In a retrospective study of 101 patients with OA undergoing TKAs at a mean of 14.6 years performed by Okamoto et al., a spinopelvic mismatch—as defined as a PI minus LL (PI-LL)  $\geq 10^\circ$ —was correlated with an artificial perception [95% confidence interval (CI): 1.29-3.22, odds ratio (OR): 1.57,  $P = 0.023$ ]. The artificial joint perception was accompanied by lower EuroQol 5-Dimension (EQ-5D) ( $P = 0.025$ ) and Knee Injury and Osteoarthritis Outcome Score-Joint Replacement (KOOS-JR) ( $P = 0.021$ ) scores. The cut-off PI-LL of  $11^\circ$  differentiated the patients with a sensitivity and specificity of 87.0% and 91.9%, respectively. Postoperative EQ-5D ( $P = 0.014$ ), KOOS-JR ( $P < 0.001$ ), satisfaction ( $P = 0.015$ ), perception ( $P = 0.032$ ), and knee extension angle ( $P = 0.024$ ) differed between the patients when the PI-LL was threshold of  $10^\circ$  (14).

#### ***Preoperative Planning for Arthroplasty in Patients with***

***Back Pain:*** A comprehensive history-taking with precise examination along with radiological assessment guides the practical management strategy. Imaging modalities, local injection installation techniques, and nerve conduction studies (NCSs) distinguish the primary pain pathology between the hip, knee, and spine. The knee alignment correction during arthroplasty could inhibit the progression or worsening of spinal degeneration. In addition, spinal alignment correction during spinal surgeries could lessen knee loading, and therefore avoid the development of degeneration.

A preoperative radiological assessment for three areas should be considered for an elderly undergoing spine surgery or knee arthroplasty. Radiological methods assess the sagittal, axial, and coronal planes to measure axis, angle, and index. The three regions inclusive of the lumbosacral spine in the lateral aspect, the pelvis and both hips in the anteroposterior (AP) aspect, and bilateral knee in the AP aspect in a hip-knee-ankle or standing posture of a long film of the lower extremity are assessed to notify corresponding degeneration of the other zones. The patient's outcome could be prognosticated pre-operatively, and the likely need for a subsequent procedure can be considered (Figure 1).

#### ***The Indications for Preoperative Radiological***

***Evaluation of the Spine:*** A bone scan may be indicated when according to the red flags findings, infection, spinal tumor, or occult fracture is suspected. However, bone scan application remains contraindicated during pregnancy (16, 17).

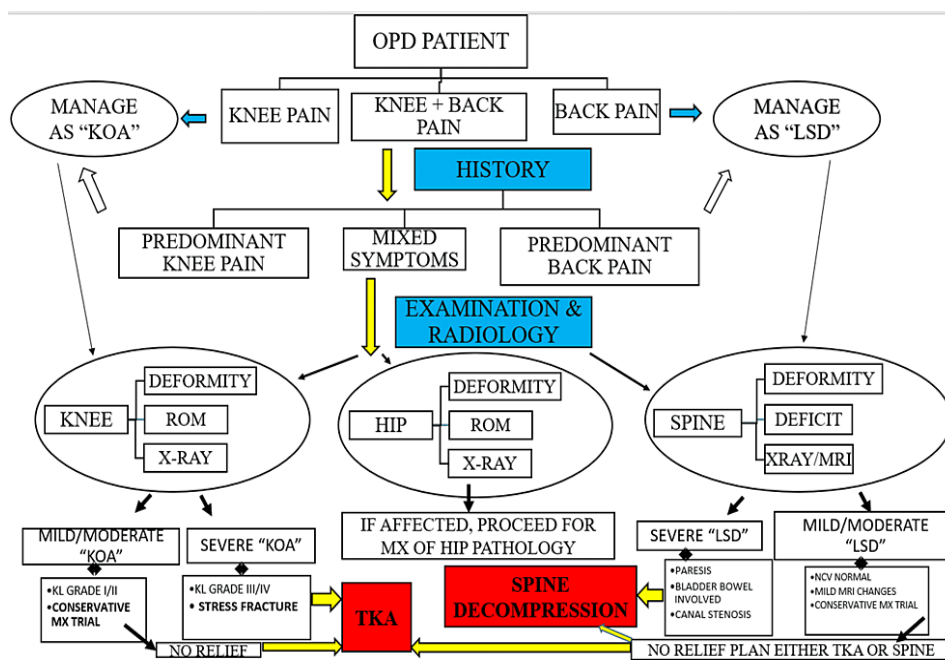


Figure 1. Outlined management strategy for patients presenting with "knee-spine syndrome"

Plain radiographs of the lumbar spine are highly suggested when red flags, including recent mild trauma (patients over age 50), recent significant trauma (any age), osteoporosis, prolonged steroid use, or patients over age 70 are present. Plain radiographs, erythrocyte sedimentation rate (ESR), and complete blood count (CBC) may be indicated for ruling out infection or tumor in those presenting with acute low back problems.

Magnetic resonance imaging (MRI) can reveal the spine condition with high sensitivity and specificity; hence, it provides a helpful modality in preoperative evaluations. Kent and Larson in analyzing 156 studies, declared that MRI provided equal or better sensitivity compared with competing modalities and also yielded greater detail than computerized tomography (CT) scans for the majority of the abnormalities (18).

If red flags exist, especially when infection or tumor is suspected, applying other imaging modalities, such as a bone scan, MRI, or CT, may be clinically recommended even during negative results of plain radiographs. When clinical findings favor infection, fracture, tumor, or any space-occupying spinal lesion, MRI, CT, CT myelography (CTM), myelography, or consultation with an appropriate specialist is recommended.

In subjects with a history of prior back surgery and acute low back problems, contrast-based MRI appears to be the imaging method of choice to appropriately differentiate scar tissue associated with prior surgery from a disc herniation (19).

Conclusion

The knee and spine are interconnected anatomically, and degenerative changes in one area could often cause discomfort in the entire axis, leading to what is known as "knee-spine syndrome". LBP is a common condition associated with knee pain and can significantly affect the results of TKA. Surgeons need to consider knee-spine syndrome before any surgical intervention in patients with knee or back pain and explain it to the patients before the surgery.

Conflict of Interest

The authors declare no conflict of interest in this study.

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