The Impact of Lumbar Spine Disease and Deformity on Total Hip Arthroplasty Outcomes

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abstract

Concomitant spine and hip disease in patients undergoing total hip arthroplasty (THA) presents a management challenge. Degenerative lumbar spine conditions are known to decrease lumbar lordosis and limit lumbar flexion and extension, leading to altered pelvic mechanics and increased demand for hip motion. In this study, the effect of lumbar spine disease on complications after primary THA was assessed. The Medicare database was searched from 2005 to 2012 using International Classification of Diseases, Ninth Revision, procedure codes for primary THA and diagnosis codes for preoperative diagnoses of lumbosacral spondylosis, lumbar disk herniation, acquired spondylolisthesis, and degenerative disk disease. The control group consisted of all patients without a lumbar spine diagnosis who underwent THA. The risk ratios for prosthetic hip dislocation, revision THA, periprosthetic fracture, and infection were significantly higher for all 4 lumbar diseases at all time points relative to controls. The average complication risk ratios at 90 days were 1.59 for lumbosacral spondylosis, 1.62 for disk herniation, 1.65 for spondylolisthesis, and 1.53 for degenerative disk disease. The average complication risk ratios at 2 years were 1.66 for lumbosacral spondylosis, 1.73 for disk herniation, 1.65 for spondylolisthesis, and 1.59 for degenerative disk disease. Prosthetic hip dislocation was the most common complication at 2 years in all 4 spinal disease cohorts, with risk ratios ranging from 1.76 to 2.00. This study shows a significant increase in the risk of complications following THA in patients with lumbar spine disease. [Orthopedics. 2017; 40(3):e520-e525.]

Degenerative diseases of the hip and spine frequently occur together, each producing a burden of pain and symptoms that can combine to create substantial morbidity and disability.1-11 Osteoarthritis is a common and inevitable systemic disease of aging for which the timing, severity, and number of joints involved are difficult to predict based on demographic factors and radiographic measures.1 The well-recognized poor correlation between radiographic severity of hip arthritis and clinical symptomatology poses a significant diagnostic challenge when patients present with concurrent low back pain, hip pain, and/or leg pain and have radiographic polyarticular disease. Hip–spine syndrome, a term first coined by Offierski and MacNab7 in 1983, is defined as the concurrent existence of osteoarthritis and degenerative lumbar spine disease. Spine pathology can present with pain and symptoms that mimic many
common disorders, including hip arthritis, trochanteric bursitis, iliopsoas impingement, sacroiliac arthritis, and piriformis syndrome. Although multiple studies have shown high sensitivity and specificity using diagnostic anesthetic hip injections to distinguish between lumbar disease and hip pathology when the anatomic source of pain is ambiguous, more often the existence of concurrent hip and lumbar spine pathology is only realized after pain persists following operative treatment for the spine or the hip. As an additional confounder, studies have also shown that total hip arthroplasty (THA) can result in significant improvement in lumbar spine pain.

Hip and spine pathology can independently and synergistically poorly affect body kinematics and locomotion. Low back pain has repeatedly been shown to limit lumbar range of motion. Thomas and France showed that low back pain and low back pain-related fear caused significant reduction in lumbar range of motion. In addition, McGregor et al showed that patients with low back pain have a reduction in lumbar range of motion in all planes (flexion/extension, lateral bending, and rotation). They separately analyzed patients with disk prolapse, degenerative disk disease, and stenosis and found a significant reduction in both lumbar flexion and extension from age-matched controls. In tasks involved in activities of daily living, these patients would likely require compensatory increases in hip range of motion to accomplish tasks necessitating motion at the extremes of range of motion (eg, tying shoes, sitting/standing from toilet or low chair, lifting object off of floor).

Degenerative changes in the spine result in hypertrophy and cystic changes of the facets, degeneration of intervertebral disks, osteophyisisis of the vertebra, and atrophy of spinal extensor muscles, which lead to a net effect of hypolordosis. Compared with age-matched controls, patients with degenerative spine disease and low back pain have a significant reduction in lumbar lordosis and sacral slope and a significant increase in pelvic tilt (or posterior tilt). The retroversion of the pelvis results in marked anteverision and abduction of the acetabulum or cup in THA. This acetabular or cup positioning can result in potential posterior impingement and anterior instability with the hips extended while standing or laying supine.

Prather et al showed that patients with lumbar spine disease have significantly less improvement in pain and functionality following THA than patients without lumbar spine disease. Furthermore, patients with lumbar spine disease have greater medical charges and longer episodes of care for THA. The discrepancy in outcomes remains unexplained. The purpose of this study was to determine the effect of lumbar spine diseases on perioperative and postoperative complications following primary THA.

**Materials and Methods**

Patients undergoing primary THA were identified from the Medicare Standard Analytical Files encompassing 100% of Medicare beneficiaries. The PearlDiver Patient Records Database (PearlDiver Technologies, Fort Wayne, Indiana) was used to search all Medicare Standard Analytical Files from 2005 to 2012 using International Classification of Diseases, Ninth Revision (ICD-9) codes. This study was institutional review board exempt because data provided in the Medicare Standard Analytical Files are anonymized without protected health information. The database was stored locally with PearlDiver Technologies on a secured server and accessed remotely through a secure connection. Data extracted from the PearlDiver database were subsequently stored on a university, password-protected computer.

The PearlDiver database was searched to identify all patients undergoing THA with and without the lumbar spine diseases of interest between 2005 and 2012.

<table>
<thead>
<tr>
<th>Code</th>
<th>Diagnosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>722.52</td>
<td>Degeneration of lumbar or lumbosacral intervertebral disk</td>
</tr>
<tr>
<td>722.10</td>
<td>Displacement of lumbar intervertebral disk without myelopathy</td>
</tr>
<tr>
<td>721.3</td>
<td>Lumbosacral spondylolisthesis without myelopathy</td>
</tr>
<tr>
<td>738.4</td>
<td>Acquired spondylolisthesis</td>
</tr>
</tbody>
</table>

Dyololisthesis met the inclusion criteria of lumbar spine disease prior to primary THA.

Group comparison of the Charlson Comorbidity Index values revealed considerable variability for each lumbar spine disease group (lumbosacral spondylosis, lumbar disk herniation, spondylolisthesis, and degenerative disk disease) and the control group (Table 2). However, despite considerable intragroup variability, a significant intergroup difference was found between all lumbar spine diseases and the control group, with the exception of the lumbosacral spondylosis group vs the disk herniation group.

Twenty-five complications were evaluated for the 4 different lumbar spine disease groups and the control group at 3 different time points. The incidence of the complications was used to determine the RR for each diagnosis and each time point. The results for surgical complications are shown in forest plots (Figures 1-4). The results for medical complications are shown in Table 3.

The RR of prosthetic joint dislocation was statistically increased for each lumbar spine disease at every time point, ranging from 1.61 to 1.85 at 90 days and from 1.63 to 1.86 at 1 year. Similarly, high RRs were seen with periprosthetic fractures, periprosthetic infection, early revision THA, and wound complications.

Compared with control patients, the risk of medical complications was statistically increased in almost all diseases at the 90-day follow-up point (Table 3).

**DISCUSSION**

The high frequency of concurrent hip and lumbar spine pathology is well documented. The combined pain, morbidity, and disability in hip–spine syndrome presents a treatment challenge for health care providers because the order and timing of intervention remains to be delineated in a prospective study. Given the systemic and ubiquitous nature of osteoarthritis and degenerative musculoskeletal disease with increasing age, differentiating between the quantity and quality of pain and disability conferred by multiple sources can be challenging. Further, even when the relative contribution from each source can be determined, no evidence-based guidelines exist regarding the order in which the hip and spine should be addressed.

Most surgeons advocate treating the most significant source of pain first; how-

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**Table 2**

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>Charlson Comorbidity Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control population</td>
<td>5.98 (3.96)</td>
</tr>
<tr>
<td>Spondylosis</td>
<td>8.03 (5.51)</td>
</tr>
<tr>
<td>Spondylolisthesis</td>
<td>7.80 (5.30)</td>
</tr>
<tr>
<td>Degenerative disk disease</td>
<td>7.90 (5.50)</td>
</tr>
<tr>
<td>Disk herniation</td>
<td>8.03 (5.60)</td>
</tr>
</tbody>
</table>

*a Mean (SD).*

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**Figure 1:** Forest plot. Risk ratios (RR) and 95% confidence intervals (CI) of complications of patients with lumbosacral spondylosis vs controls. Abbreviation: THA, total hip arthroplasty.

**Figure 2:** Forest plot. Risk ratios (RR) and 95% confidence intervals (CI) of complications of patients with lumbar disk herniation vs controls. Abbreviation: THA, total hip arthroplasty.

**Figure 3:** Forest plot. Risk ratios (RR) and 95% confidence intervals (CI) of complications of patients with acquired spondylolisthesis vs controls. Abbreviation: THA, total hip arthroplasty.

**Figure 4:** Forest plot. Risk ratios (RR) and 95% confidence intervals (CI) of complications of patients with degenerative disk disease vs controls. Abbreviation: THA, total hip arthroplasty.
ever, given the interconnectedness of the lumbar spine and pelvis, it is possible that the order of treatment plays a significant role in operative complications and outcomes. Correction of pelvic obliquity in the setting of scoliosis through intentional leg lengthening during THA could potentially result in iatrogenic pelvic obliquity if the scoliosis is then subsequently corrected through spinal deformity correction. Similarly, restoration of lordosis during spinal reconstruction could flattened a THA cup, leading to posterior hip instability and anterior impingement, while iatrogenic loss of lordosis during spinal reconstruction could overly antevert and abduct a THA cup, leading to anterior insta- bility and posterior impingement. It is likely that these scenarios of anterior and posterior instability account for at least part of the significantly elevated rates of prosthetic hip dislocation in this study.

In their 2012 study, Prather et al27 showed that patients with lumbar spine disease undergoing THA had significantly less improvement in pain and functional- ity, greater medical charges, and longer episodes of care following THA than patients without lumbar spine disease. The outcome measures used in that study included visual analog scale score, Harris Hip Score, and University of California Los Angeles activity score, which the authors suggest might have even led to an underestimation of the impact of lumbar spine disease because their outcome measures only targeted hip pain. The authors attributed the discrepancy in outcomes between the 2 cohorts primarily to the effects of the untreated lumbar spine disease.

In the current study, the authors found that patients with degenerative disk disease, lumbar disk herniation, spondylosis, or spondylolisthesis all had statistically increased risk of postoperative prosthetic hip dislocation, revision THA, periprosthetic fracture, and prosthetic joint infection. The significant difference in complications compared with the control population is likely due to multiple factors, including decreased general conditioning, pain- or fitness-limited postopera-

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### Table 3

<table>
<thead>
<tr>
<th>Complication</th>
<th>Control</th>
<th>Spondylosis</th>
<th>Disk Herniation</th>
<th>Spondylolisthesis</th>
<th>Degenerative Disk Disease</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>RR</td>
<td>95% CI</td>
<td>RR</td>
<td>95% CI</td>
<td>RR</td>
</tr>
<tr>
<td>Myocardial infarction</td>
<td>2.05%</td>
<td>1.00</td>
<td>0.96-1.05</td>
<td>0.97</td>
<td>0.91</td>
</tr>
<tr>
<td>Heart failure</td>
<td>6.60%</td>
<td>1.24</td>
<td>1.21-1.27</td>
<td>1.13</td>
<td>1.10</td>
</tr>
<tr>
<td>Arrhythmia</td>
<td>16.03%</td>
<td>1.20</td>
<td>1.17-1.22</td>
<td>1.15</td>
<td>1.12</td>
</tr>
<tr>
<td>Respiratory failure</td>
<td>1.10%</td>
<td>1.31</td>
<td>1.24-1.39</td>
<td>1.32</td>
<td>1.23</td>
</tr>
<tr>
<td>Deep venous thrombosis</td>
<td>2.59%</td>
<td>1.26</td>
<td>1.21-1.31</td>
<td>1.35</td>
<td>1.29</td>
</tr>
<tr>
<td>Pulmonary embolism</td>
<td>0.90%</td>
<td>1.33</td>
<td>1.25-1.41</td>
<td>1.36</td>
<td>1.26</td>
</tr>
<tr>
<td>Stroke</td>
<td>0.89%</td>
<td>1.34</td>
<td>1.26-1.42</td>
<td>1.35</td>
<td>1.25</td>
</tr>
<tr>
<td>Pneumonia</td>
<td>2.85%</td>
<td>1.20</td>
<td>1.16-1.25</td>
<td>1.17</td>
<td>1.12</td>
</tr>
<tr>
<td>Sepsis</td>
<td>1.22%</td>
<td>1.21</td>
<td>1.15-1.28</td>
<td>1.15</td>
<td>1.07</td>
</tr>
<tr>
<td>Acute renal failure</td>
<td>3.42%</td>
<td>1.23</td>
<td>1.24-1.32</td>
<td>1.15</td>
<td>1.11</td>
</tr>
<tr>
<td>Urinary tract infection</td>
<td>11.10%</td>
<td>1.23</td>
<td>1.21-1.25</td>
<td>1.19</td>
<td>1.16</td>
</tr>
<tr>
<td>Anemia (postoperatively)</td>
<td>26.88%</td>
<td>1.21</td>
<td>1.19-1.22</td>
<td>1.19</td>
<td>1.17</td>
</tr>
</tbody>
</table>

*Abbreviations: CI, confidence interval; RR, risk ratio.

*Incidence.*
abnormal gait and decreased ability to adjust to imbalance and protect against falls.

Given the limited lumbar flexion (extrinsic pelvis flexion) in patients with lumbar spine disease, it is possible that these patients rely more on intrinsic pelvic flexion through the hip joints to accomplish activities of daily living, including sitting/rising from a toilet or low chair. Accordingly, patients with lumbar spine disease may be routinely exceeding the postoperative range of motion limitations issued by many surgeons, potentially increasing the likelihood of periprosthetic hip dislocations. Potential strategies to decrease dislocation include adjusting range of motion limitations, modifying component positioning (version and offset) to emphasize stability over range of motion, or modifying component selection (constrained liners, dual-mobility liners, or larger femoral heads).

The interconnectivity of the hip and spine demands consideration of pelvic parameters during THA component positioning. The hyplordosis that results from degenerative spine disease leads to thoracic hyperextension, forward tilt of the trunk, knee flexion, hip extension, and increased pelvic tilt, causing positive sagittal balance and increased acetabular anteversion and abduction.20,29-31 If the acetabular cup in a THA is implanted in the “safe zone” described by Lewinnek et al12 according to a supine anteroposterior pelvis radiograph, the cup will be overly abducted and anteverted when the patient is standing because of increased pelvic retroversion. This requisite hip hyperextension to compensate for pelvic retroversion will lead to potential posterior hip impingement and anterior instability. Therefore, preoperative templating of THA components should account for pelvic tilt in the standing position to ensure that components are implanted according to the functional position of the pelvis.

The calculated RRs in this study likely underestimate the true impact of the lumbar spine diseases, as it is well-known that spine pathology is frequently not diagnosed in patients undergoing THA until the preoperative pain is not resolved postoperatively and necessitates more comprehensive evaluation. If these patients were removed from the control group, it is possible that discrepancy in complication profiles would further increase.

Significant but lower-magnitude increases in medical complications were seen in the lumbar spine disease populations relative to controls. Although several of these complications could be partially explained by decreased mobility and slowed ambulation recovery in the lumbar spine disease population secondary to baseline differences in mobility and activity compared with controls (pulmonary embolism, deep venous thrombosis, pneumonia), increases were seen in complications that are not easily relatable to activity. Accordingly, in the population undergoing THA, the concurrent diagnosis of a lumbar spine disease may simply be a marker of generalized inferior health status and the increased rate of medical complications may not be directly attributable to the lumbar spine disease.

This study had important limitations. Anonymized, conglomerate data were used, and the incidence of complications and the prevalence of disease are continent on proper coding using ICD-9 codes. The severity and chronicity of the lumbar spine diseases and complications could not be quantified and there was no control for lumbar spine interventions (either prior to or following THA). Further, this database only includes Medicare beneficiaries (generally 65 years or older) and its contents may not be generalizable to other ages or countries. Finally, in this study, outcome data were limited to complications that could be identified from ICD-9 codes and did not include functional measures, pain scores, or other patient-reported outcome measures. This is an inherent limitation of the Medicare Standard Analytical Files data.

**CONCLUSION**

In this evolving era of managed-care and results-driven policies for treatment approval and reimbursement, it is essential to assess factors that portend good and bad outcomes. The data presented here should be discussed with patients preoperatively to set expectations and quantify risk. Although THA provides excellent improvement in quality of life for patients with lumbar spine disease, it is important to recognize that these patients face elevated risk of complications and may have a lower ceiling for potential improvement. Comprehensive understanding of potential complications can govern the aggressiveness of treatments and guide investigation into alternative treatments, protocols, or operative techniques.

**REFERENCES**


Feature Article


