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## Impact of co-existent lumbar spine disorders on clinical outcomes and physician charges associated with total hip arthroplasty

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### Abstract

**Background Context**—Despite the common prevalence of lumbar spine and degenerative hip disorders, there are few descriptions of patients with coexisting hip and lumbar spine disorders. The independent economic burden of each disorder is substantial but the financial burden when the disorders are coexisting is unknown.

**Purpose**—The purpose of this study is to determine the prevalence of coexisting hip and lumbar spine disorders (LSD) in a large cohort of patients with hip osteoarthritis treated with total hip arthroplasty (THA) and determine the impact on pain and functional THA outcomes and physician charges.

**Study Design/Setting**—This is a retrospective study performed at a tertiary university.

**Patient Sample**—3206 patients who underwent total hip replacement from 1996-2008.

**Outcome Measures**—Self-report measures: Visual Analog Scale. Functional measures: modified Harris Hip Score (mHHS), UCLA hip questionnaire. Economic impact measures: physician medical charges.

**Methods**—International Classification of Diseases (ICD-9) billing codes related to LSDs were cross referenced with the 3206 patients who had undergone a THA to determine which patients were also evaluated by a spine specialist. Demographic, hip clinical outcomes and physician

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charges for patients with THA alone (THA alone) were compared to patients treated with THA and diagnosed with a LSD (THA + LSD).

**Results**—Of 3206 patients who underwent THA, 566 (18%) were also evaluated by a spine specialist. Of those with a LSD, 334 (59%) were women with an older average age (64.5+13.3yrs) compared to patients treated with THA alone (51%, 58.5+15.5 yrs,  $P=0.0001$ ). Patients in the THA alone group as compared to the THA+ LSD group had greater improvement in the mHHS ( $P=0.0001$ ), UCLA score ( $P=0.0001$ ) and pain ( $P=0.0001$ ). Patients in the THA+LSD group incurred on average \$2,668 more in charges per episode of care as compared to patients in the THA alone group. ( $P<0.001$ ) Patients in the THA+LSD group had more days per episode of care ( $P=0.001$ ).

**Conclusions**—Patients undergoing THA alone had greater improvement in function and pain relief with fewer medical charges as compared to patients undergoing a THA and treatment for a LSD. The prevalence of coexisting hip and spine disorders is likely higher than currently documented. Further study is needed in order to improve therapeutic recommendations and determine the potential for reduction in medical expenses associated with concurrent treatment of hip osteoarthritis and lumbar spine disorders.

### Keywords

hip; arthroplasty; lumbar spine; low back pain; osteoarthritis; hip-spine syndrome

### Introduction

Hip and spine disorders cause significant impairment and disability. The exact prevalence of these two conditions occurring together, namely the hip-spine syndrome, is unknown. Yet, coexistent disease is commonly observed in the clinical setting. The impact of these coexistent conditions on disease progression and response to treatment is also not known. Further, the healthcare costs of coexisting disorders are unknown. Improved diagnosis of these coexisting conditions will direct patient care and improve patient management and outcomes. Further, health care costs potentially could be reduced if treatment for the two conditions is coordinated and administered concurrently as compared to common practice where the failure of treatment of one may then lead to a diagnostic evaluation and eventual treatment of the other disorder. A reduction in the delay of diagnosis and evaluation allows for the integration of treatment for both conditions from the onset of care, the setting of appropriate outcome goals, and potentially reduce time lost from work and activities.

Descriptions of the hip-spine syndrome are limited to coexisting hip and spine dysfunctions that occur in the setting of hip and spine degenerative changes noted on imaging.[1-8] Reference to the coexistence of hip and spine disorders was first published by Bohl [2]. The authors described the course of six patients with continued pain after a total hip arthroplasty (THA) that was relieved with a lumbar laminectomy. In a similar study, McNamara[5] described symptomatic lumbar spinal stenosis in nine patients following THA. Seven of the patients went on to have a lumbar decompression and the surgeons reported excellent or good outcomes. Saunders and colleagues[7] evaluated 75 patients with hip osteoarthritis (OA) and compared them to a control group of patients without hip OA. Lumbar spine degenerative changes were significantly more common (women  $p=0.036$  and men  $p=0.001$ ) in the hip OA patients as compared to controls. The hip-spine syndrome term was first published by Offierski [6] in 1983. The authors described the course of 35 patients and concluded that patients with concomitant hip and spine disorders need specific diagnostic tests to assess which or if both disorders cause the greatest impairment. If the impairments are “inter-related” the authors concluded that addressing the hip disorder will modify the symptoms from the lumbar spine.

Fogel [3] described the constellation of symptoms in patients considered to have hip-spine syndrome with degenerative hip disease and spinal stenosis. The first study to comment on intervention for this patient population was published by Ben-Galim in 2007. [1] In this study, 25 patients were evaluated with the Harris Hip Score, Oswestry Disability Index, and pain visual analog scales for the hip and spine prior to, three months, and two years after THA. All outcome measures reached statistically significant improvement after THA. The authors concluded that THA improved lumbar spine pain. In a recent retrospective review by Sembrano and Polly[8] 200 patient records from a spine surgery service were evaluated. Eighty-two percent of cases reported lumbar spine pain, 12.5 % of cases reported hip pain, and 14.5% reported sacroiliac joint pain. Seventeen and one-half percent reported pain in all 3 locations.

Diagnosing hip and spine conditions when they coexist is difficult. This is, in part, due to the similarity of symptoms which may lead to undetected overlap of the two disorders. Lumbar radiculopathy, facet syndrome, sacroiliac joint pain, and piriformis syndrome may present with similar distributions of pain including the lumbar spine, posterior pelvis, lateral hip, groin, and lower extremity.[9-13] Less recognized are the various distributions of symptoms related to hip disorders. Khan 2004[4] reported that 47% of patients with hip OA undergoing THA had pain in the lower extremity below the knee. Leshner [14] reported patients responding to intra-articular hip injection reported pain in the groin, lateral hip, buttock region, anterior and posterior lower extremity. Pre-arthritis hip disorders (acetabular labral tears, femoroacetabular impingement, developmental hip dysplasia) have also been described to present with buttock and/or LBP. [15-18] Because of the overlap in symptoms and diagnostic imaging findings, the specialist must often rely on their individual clinical experiences to direct diagnostic testing and treatment recommendations.

To date, there are no large scale studies that describe this group of patients with coexisting hip and spine conditions. Despite the suspicion that the financial impact of these coexisting conditions is significant, there is also no literature that attempts to describe the magnitude of the impact. Patients that have undergone a THA for a degenerative condition represent a group of patients at the end of the spectrum for degenerative conditions of the hip joint. The literature supports that patients with degenerative hip disorders are likely to have degenerative changes in the lumbar spine.[7] How many of these patients seek treatment for a painful lumbar spine disorder (LSD) is unknown but this group represents a specific population affected by coexisting hip and spine disorders. It is important to raise awareness of the prevalence of coexisting hip and spine disorders so that physicians attempt to assess for both in patients presenting with pain in the lumbar spine and pelvic region. Improved awareness may also direct specific treatment for both disorders.

The purpose of this study is to determine the prevalence of coexisting hip and LSDs in a large co-hort of patients treated with THA and determine the impact on pain and functional THA outcomes and physician charges. To that end, this study describes patient characteristics, clinical outcomes and physician charges for patients treated with a THA alone (THA alone group) and compares them to patients treated with THA who were also treated for a LSD (THA + LSD group) at a tertiary university orthopedic department.

## Materials and Methods

After receiving the institutional review board approval, the University's Orthopaedic Hip Repository was utilized to retrospectively identify and describe patients who had undergone THA in the orthopaedic department between 1996 and 2008. The hip repository, with data from over 3200 patients treated with THA, served as a source to identify patients with end stage degenerative hip arthritis. The patients from the hip repository were cross-referenced

by International Classification of Diseases version 9 (ICD-9) billing codes with 22 codes submitted for LSDs by spine specialists (including all university physical medicine and rehabilitation and orthopaedic spine physicians employed by the department of orthopaedic surgery) for the two years preceding or following the THA performed at Washington University. A list of these codes and their descriptions are found in Table 1. This time frame of four years was used to best determine the presence of coexisting hip and spine disorders rather than an episode of low back pain remote to the time of the THA. Spine specialists included orthopaedic spine surgeons and physical medicine and rehabilitation physicians. Codes related to spinal fracture, tumor, scoliosis, or metabolic disorders were excluded because these diagnoses represent sub-groups of lumbar spine disorders that involve systemic or structural disorders that may impact the hip outside of the usual parameters of the natural course of aging.

The hip repository contains prospectively collected data for all consenting patients undergoing treatment directed by orthopaedic joint replacement surgeons for hip disorders. The data is collected in an electronic storage system, Patient Analysis and Tracking System (PATS), and contains patient demographics, self report of pain via a visual analog scale (VAS) (0-10) for hip pain, and standardized and validated questionnaires used to assess impairments and functional limitations (modified Harris Hip Score, mHHS)[19] and activity (UCLA activity score)[20].

Physician charges for services were estimated from department billing records between 1996 and 2008. Sixty-four patients were randomly selected from a pool of patients in the hip registry who received a THA from the years 1996-2008 after patients with THA and a LSD diagnosis were removed for selection. This randomly selected group served as a control group and was used to assess the charges because of the size of the THA alone group was large (n=2,641 patients) and burdensome to analyze. An analysis was completed to compare baseline demographics, pain, function, and activity measurements of the 64 patients serving as controls to the remaining 2,577 patients in the THA alone group. This was completed to insure the controls randomly selected were representative of the THA alone group. Total physician billings were then extracted from the records of the 64 patients in the control group and 565 patients from the THA+LSD group and compared.

Physician outpatient charges for episodes of care were averaged. An episode of care was defined as the first office visit the patient had with a hip or spine specialist to the last visit the patient had for either the hip and/or the LSD at this institution with the last visit occurring before January of 2009. If the patient was evaluated for a LSD prior to THA, then the episode of care began at a maximum of two years prior to the hip replacement. If the patient was treated for a THA prior to a LSD, then the episode of care began with the first visit the patient was evaluated for the THA. For patients in the THA alone group, the episodes of care were estimated for care specific to their THA. This included the office visits that started with the initiation of evaluation through follow-up post-operative visits. For the THA+LSD group, the episodes of care included evaluation and treatment of their LSD in addition to care specific to their THA.

## Statistical Methods

A comparison of patient demographics, pain reports, HHS, and UCLA activity scores was completed between patients in the THA alone group and the THA+LSD group. A comparison of gender was performed with a chi-square test of independence. An independent samples t-test was used to compare age at first surgery between groups. Wilcoxon's test compared the number of observations per patient. The primary analysis was a comparison of change from pre- to post-surgery THA alone group versus THA+LSD

group using Generalized Estimating Equations (GEEs) where the post-surgery value of an outcome measure was the dependent variable, the THA alone group was the independent variable, and the pre-surgery value was the covariate. Some patients contributed data for both the right and left side, and for multiple surgeries per side. Since these data are not independent, the GEE model accounts for the correlation of multiple measurements within a patient. Analyses of ordinal scaled variables (i.e., UCLA and pain) were modeled with multinomial probability distributions and cumulative logit link functions to account for the ordering of response categories.

The mean charges for an episode of care for cases and controls were compared using multivariable generalized linear modeling. The total and allowable physician charges associated with the ICD-9 billing codes related to the patient's hip and spine care were also calculated. The charges for 64 patients used as controls from the THA alone group were compared to the 565 patients from the THA+LSD group. The mean total charges and duration for the episode of care (defined as the time from the first date of service in the billing records to the final) was estimated, and compared using the student t-test.

## Results

Of the 3206 patients who underwent THA, 565 (18%) were also evaluated and diagnosed with a LSD by a spine specialist in the department of orthopaedic surgery between 1996 and 2008. Patients in the THA+LSD group were more commonly women and significantly older as compared to patients in the THA alone group (Table 2). Patients in both groups demonstrated significant improvement in the VAS, mHHS, and UCLA scores after THA (Table 3). Patients in the THA alone group had significantly greater improvement in pain and function after THA as compared to patients in the THA+LSD group. Specifically, self-reported pain improvement was significantly greater in patients in the THA alone group. Patients in the THA alone group also had significantly greater improvement in the mHHS and UCLA scores as compared to patients in the THA+LSD group.

Further analysis was completed to assess for differences in patients within the THA+LSD group regarding the timing of the diagnosis of the LSD in relationship to the timing of the THA. No significant differences in age ( $p=0.38$ ), gender ( $p=0.68$ ), baseline report of pain ( $p<0.99$ ), function (mHHS  $p<0.12$ ) or activity (UCLA  $p<0.30$ ) were found between patients diagnosed with a LSD before or after the THA.

Analysis comparing the 64 patients randomly selected from the THA alone group to the remaining 2,577 patients in the THA group was completed to insure these randomly selected patients were representative of the entire THA alone group. No differences were found between the controls and remaining members of the group regarding age ( $p=0.81$ ), gender ( $p=0.92$ ), VAS ( $p<0.92$ ), mHHS ( $p<0.88$ ) and UCLA score ( $p<0.57$ ). This confirmed the randomly selected control patients were appropriate to serve as controls for the THA alone group and comparisons between physician billings of the THA alone and THA+LSD could be conducted with accuracy.

A patient in the THA+LSD group incurred on average \$6,098 in billed charges for an episode of care, while a control patient from the THA alone group incurred \$4,273 (\$1,825 less, a difference of 35%). This difference was significant ( $p<0.001$ ). On average, patients in the THA+LSD group had an episode of care that lasted 2,166 days (5.93 years), 568 days longer than patients in the THA alone group. This difference was also significant ( $P<0.001$ ).



## Discussion

To date, this is the largest patient data set reviewed to assess the coexistence of hip and spine disorders and compare patient characteristics and outcomes after THA. We found that in our population of patients, those with coexisting disorders were more likely to be women and older as compared to patients undergoing THA alone. Similar to the study by Ben-Galim [1], we found that patients with a LSD and a degenerative hip disorder significantly improved after THA. However, we found that patients with both a LSD and THA did not improve as much as patients with THA alone in self-report of pain, function (mHHS) and activity level (UCLA score). While the actual differences in outcomes were small between these groups, the differences were statistically significant. Furthermore, the findings of this study may underestimate the actual impact of LSD as the outcomes measures targeted hip pain, not LSD. That being said, both of these questionnaires contain questions that could also be affected by coexisting LSD. These questions include: activity level, pain medication usage, and specific activities of daily living. The VAS was used to assess hip pain but patients with both a LSD and THA may have had difficulty in consistently differentiating low back pain from hip pain. Further the mHHS and the UCLA activity score do not have established minimal clinically important differences. The differences found between the groups were statistically significant but the retrospective design may not have allowed for the detection of even greater differences. Despite this overlap in assessment of function and pain, patients in the THA+LSD group had less improvement.

This is also the first study to attempt to examine the charges associated with the evaluation and treatment of patients with coexisting hip and spine disorders. Patients who underwent a THA and were treated for a LSD had significantly greater physician charges. The THA +LSD group required more office visits to the physician over a longer period of time. This implies the LSD contributed to the need for ongoing care. Because of the retrospective design of this study, it is unknown if the treating physician recognized the patient to have symptoms related to the hip and spine at the time of evaluation and treatment recommendation. Our intent of reporting physician charges in this retrospective study was to: 1) describe that patients with coexisting hip and lumbar spine disorders are a specific subgroup of patients that require more time and money to manage and 2) establish an understanding that the physician charges are greater for patients with coexisting hip and lumbar spine disorders. The latter sets a baseline for future prospective studies to identify relative costs and determine value associated with evaluation and treatment of patients with co-existing disorders.

In our experience, patients treated for one disorder experience unsatisfactory improvement in function and pain before the coexisting condition is evaluated. This delay in treatment has the potential to foster chronicity and disability. Further, another specialty consultation is often triggered. Early recognition by healthcare providers that two disorders instead of one need evaluation and treatment from the onset of care might have a favorable impact on outcomes and cost of care. This should be tested by future studies.

The history and clinical presentation of patients with hip and spine disorders are not uniform. Further, determining if the primary impairment is related to the lumbar spine or hip disorder can be complex due to the insidious onset of symptoms, overlap in distribution of symptom location, concomitant symptom provocation on physical examination, and imaging findings that do not consistently correlate with the patient's symptoms. The biomechanics and kinesiology of the lumbar spine, pelvis, and hip is complex and the interrelations between the regions can easily go unrecognized. One approach as described by Sembrano and Polly[8] is to use image guided injections to help delineate between regions and confirm that structures in more than one region may be the source of pain. In general, the patient's

report of at least 50% of pain with an injection may provide guidance[21] but cannot confirm the source of pain in isolation with respect to the lumbar spine and sacroiliac joint. [22] Also, injections do not identify all sources of extra-articular hip and pelvic girdle pain especially pain related to dynamic movement impairments. The diagnostic utility for hip injections has been demonstrated. Byrd[23] found a 93% correlation in patients who experienced pain relief with image guided anesthetic injections of the hip with findings on hip arthroscopy. Pateder [24] found anesthetic injections of the hip to be 100% sensitive and 81% specific in predicting a hip disorder is present versus a lumbar spine disorder. Although injections may provide some guidance, further studies are needed to prospectively determine the best methods for evaluating this patient population.

There are several limitations of this study. First, because this is a retrospective review utilizing ICD-9 billing codes to identify patients, we were unable to specifically describe the types of lumbar spine disorders that the patients with THA were evaluated for during the course of their care. Descriptive information regarding the lumbar spine disorders would improve physician awareness of a potentially co-existing disorder. Second, we cannot confirm that every patient in the THA alone group did not seek treatment from healthcare providers outside the department of orthopaedic surgery. Also, if a patient moved from the region in the year following their one year follow-up visit regarding their THA and developed a LSD, this patient would not have been counted in the THA+LSD group.

Despite these limitations, we found significant differences between the groups in all factors studied that may indicate that our 18% prevalence rate is an underestimation of coexistent disorders. If all healthcare providers for every patient could have been identified, the significance of the differences between the two groups would likely have increased. Data specific to the LSD in patients in the THA+LSD group is unknown as a repository for all types of LSDs does not exist. Data regarding the LSD would be useful to guide physicians diagnosing and treating patients with co-existing disorders. Finally, as this sample was drawn from one orthopaedic department in a university setting, it is not possible to know if our comparison of the charges per episode of care is biased due to a difference in loss of follow-up between the THA alone group and THA+LSD group. These limitations point to the need for prospective investigations to describe the co-existence of hip and spine disorders in the setting of degenerative and nondegenerative underlying structural disorders. Specifically, it is important to identify history, physical examination, and imaging findings unique to patients with symptoms and reduced function related to: 1) coexisting disorders in the setting of structural changes of the hip (examples: pre-arthritis hip disorders, and hip osteoarthritis) and/or spine (examples: disc changes, spinal stenosis, facet arthropathy) or 2) aberrant movement patterns (both active and passive) of one region provoke or are associated with symptomatic findings in the other region. An example of the latter includes literature that describes a reduction in hip internal rotation found in patients with LBP who participate in rotational sports. [25-27] These descriptive investigations can lead to diagnostic confirmation and eventually randomized controlled clinical trials. Particularly in the setting of co-existing disorders, the timing of intervention needs to be investigated.

For now, the clinician is left to rely on his or her own clinical judgment. In our experience, if a patient's primary impairment is the inability to weight-bear due to pain related to a hip disorder, often the hip disorder is treated first. Likewise, patients in whom the primary impairment is the inability to perform daily functions due to neurogenic pain, we opt to treat the spine condition first. Often, treating one disorder allows for easier management of the other. Further, less invasive interventions such as directed therapeutic exercise, education in activity modification, and therapeutic injections may reduce pain related to the two conditions and allow for successful management as evidenced by reduction in pain, improved function, and improved patient satisfaction.

## Conclusions

In this study, the prevalence of a LSD in the setting of advanced hip osteoarthritis treated with THA was 18%. Patients with THA and a LSD were older, more commonly women, and did not report as much improvement in pain and function after THA as compared to patients undergoing THA alone. Patients with THA and LSD were evaluated by a physician over a longer period of time and incurred greater charges as compared to patients with THA alone. Further studies are needed to prospectively describe this patient population and determine diagnostic tools to best evaluate and determine when hip and spine disorders occur in isolation and when they coexist. Evaluation of treatment interventions and timing of these interventions is necessary to improve patient care and patient outcomes. Early awareness of coexisting hip and spine disorders may help to reduce health care costs associated with both of these economically burdensome disorders.

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**Table I**

## ICD-9 Low Back Codes

Low Back ICD-9 Codes	Description
721.3	Lumbosacral spondylosis w/o myelopathy
721.42	Lumbar spondylosis with myelopathy
721.90	Spondylosis, unspecified without myelopathy
721.91	Spondylosis, unspecified with myelopathy
722.10	Displacement of lumbar intervertebral disc without myelopathy
722.2	Displacement of intervertebral disc, site unspecified, without myelopathy
722.32	Schmorl's nodes, lumbar region
722.52	Degeneration of lumbar or lumbosacral intervertebral disc
722.6	Degeneration of intervertebral disc, site unspecified
722.73	Intervertebral disc disorder with myelopathy, lumbar region
722.83	Postlaminectomy syndrome, lumbar region
722.93	Other unspecified disc disorder, lumbar region
724.02	Spinal stenosis, lumbar region
724.2	Lumbago
724.3	Sciatica
724.4	Thoracic or lumbosacral neuritis or radiculitis, unspecified
724.5	Backache, unspecified
724.6	Disorders of sacrum
756.10	Anomaly of spine, unspecified
756.11	Spondylolysis, lumbosacral region
756.12	Spondylolisthesis

**Table II**

Comparison of patient characteristics by group.

Variable	THA alone group (N=2641 patients)	THA+LSD group (N=565 patients)	P-value
gender: male female	1302 (49%) 1339 (51%)	231 (41%) 334 (59%)	0.0003*
age at first surgery	58.5 ± 15.5	64.0 ± 13.3	<0.0001 <sup>+</sup>

Group 1: patients treated with THA alone

Group 2: patients treated with THA and evaluated for a LSD

N = sample size. Data are the number of patients (percent of group) or mean ± standard deviation or median [interquartile range].

\* based on chi-square analysis

<sup>+</sup> based on unpaired t-test

**Table III**

Comparisons of change in function, activity level and self-report of pain between groups

Variable	Time Point	THA alone group (N=3134 observations <sup>‡</sup> )	THA+LSD group (N=712 observations <sup>‡</sup> )	P-value *
Self Report of Pain	preop postop change P-value within group <sup>‡</sup>	7.55 ± 2.1 1.40 ± 2.2 -6.15 ± 2.9 <0.0001	7.73 ± 2.1 2.23 ± 2.8 -5.50 ± 3.3 <0.0001	<0.0001
Harris Hip Score, Surgical side	preop postop change P-value within group <sup>‡</sup>	49.4 ± 16 85.8 ± 16 36.4 ± 18 <0.0001	46.6 ± 14 79.0 ± 19 32.4 ± 21 <0.0001	<0.0001
UCLA	preop postop change P-value within group <sup>‡</sup>	4.02 ± 2.2 5.82 ± 2.2 1.80 ± 2.3 <0.0001	3.49 ± 1.9 4.77 ± 2.0 1.29 ± 2.2 <0.0001	<0.0001

Change = post-surgery score – pre-surgery score. Data are mean ± standard deviation. Post-surgery data is from 1 year follow-up

\* P-value associated with change from pre-surgery to post-surgery between groups by Generalized Estimating Equations( GEE.)

<sup>‡</sup> P-value associated with change from preop to postop within group by GEE.

<sup>‡</sup> Maximum sample size available per group and includes bilateral THA