Trends in Inpatient *versus* Outpatient Lumbar Microdiscectomy in the United States of America: An Epidemiologic and Economic Analysis

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ABSTRACT

Objective: *Lumbar discopathy is the most common cause for lower back-pain with the exception of non-specific lower back-pain. Lumbar microdiscectomy is the number one neurological surgery procedure performed in the country and is the first major spine surgery to transition to the ambulatory setting. Analysis on a national level is important to understand the transition in healthcare. The authors aim to report on the incidence of lumbar microdiscectomy and the associated procedural reimbursement costs over a seven-year period using a national database in the United States of America (USA).*

Methods: *A query was performed for patients who underwent lumbar microdiscectomy using the Pearldiver Supercomputer (Warsaw, IN) from 2007 to 2014. Patients were identified by current procedural terminology (CPT) codes 63020, 63030 and 63035 and their demographics, location of surgery and reimbursement costs were later analysed.*

Results: *The query returned a total of 38 636 lumbar microdiscectomies over the seven-year study period of 2007 to 2014. The total number of procedures performed as outpatients increased significantly from 906 in 2007 to 2647 in 2014 (*$p = 0.015$*); whereas those performed as inpatients had a smaller increase from 2437 in 2007 to 2788 in 2014 (*$p = 0.888$*). Of the total amount of surgeries, 20 884 (60.1%) were performed in the inpatient setting compared to 12 765 (39.9%) in an outpatient setting, (*$p < 0.001$*). The seven-year mean reimbursement cost for lumbar microdiscectomy done in the inpatient setting was $809.75 compared to $4181.88 in the outpatient setting, which was statistically significant (*$p = 0.027$*). Correlation analysis demonstrated that the increase in the incidence of outpatient lumbar microdiscectomy being performed had a high correlation (*$R = 0.914$*) to reimbursements, with a significance of* $p = 0.002$.

Conclusion: *There has been a significant increase in lumbar microdiscectomy over the past seven years being performed as outpatient procedures. Mean reimbursement was shown to be a significant correlating factor for this increase.*

Keywords: Cost reimbursement, economic analysis, epidemiology, incidence, lower back-pain, lumbar microdiscectomy, lumbar spine, national sample

Tendencias de la microdiscectomía lumbar intrahospitalaria frente a la ambulatoria en los Estados Unidos de América: un análisis epidemiológico y económico

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RESUMEN

Objetivo: *La discopatía lumbar es la causa más común de dolor de espalda baja con excepción del dolor de espalda baja no específico. La microdiscectomía lumbar es el procedimiento de cirugía*

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neurológica número uno realizado en el país y la primera cirugía mayor de columna vertebral en transitar al contexto ambulatorio. El análisis a nivel nacional es importante para entender las transiciones en la atención a la salud. Los autores tienen por objeto informar sobre la incidencia de la microdiscectomía lumbar en los Estados Unidos de América (EE.UU.), utilizando una base de datos nacional de un período de siete años y los costos de reembolso asociados con los procedimientos.

Métodos: *Se realizó una pesquisa de pacientes que fueron sometidos a microdiscectomía lumbar usando la supercomputadora PearlDiver (Warsaw, IN) de 2007 a 2014. Los pacientes fueron identificados mediante los códigos 63020, 63030 y 63035 de la terminología actualizada de procedimientos médicos (CPT, siglas en inglés), y la demografía, lugar de la cirugía y los costos de reembolso fueron analizados posteriormente.*

Resultados: *La pesquisa arrojó un total de 38636 microdiscectomías lumbares durante el período de estudio de siete años, de 2007 a 2014. El número total de procedimientos realizados de forma ambulatoria aumentó significativamente de 906 en 2007 a 2647 en 2014 (*p *= 0.015), mientras que los realizados con carácter intrahospitalario tuvieron un aumento menor de 2437 en 2007 a 2788 en 2014 (*p *= 0.888). Del total de cirugías, 20884 (60.1%) se realizaron en el contexto de pacientes hospitalizados, en comparación con 12765 (39.9%) realizadas en el contexto ambulatorio, (*p *< 0.001). El costo de reembolso promedio de siete años para la microdiscectomía lumbar realizada en el contexto de la hospitalización fue de $809.75, comparado con $4181.88 en el contexto ambulatorio, que fue estadísticamente significativo (*p *= 0.027). El análisis de la correlación demostró que el aumento en la incidencia de la microdiscectomía lumbar, tuvo una alta correlación (R = 0.914) con los reembolsos, con una significación de* p *= 0.002.*

Conclusión: *Ha habido un aumento significativo en la microdiscectomía lumbar en los últimos siete años como procedimiento ambulatorio. El reembolso promedio mostró ser un factor correlativo significativo para este aumento.*

Palabras claves: reembolso de costos, análisis económico, epidemiología, incidencia, dolor en la parte baja de la espalda, microdiscectomía lumbar, columna lumbar, muestreo a nivel nacional

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INTRODUCTION

The prevalence of lower back-pain (LBP) in the United States of America (USA), is at an undeniably high level. Serving as the fifth most popular reason for visiting a physician (1), LBP affects nearly 28% of all adult Americans (2) and yields an estimated 34 billion dollar incremental cost burden on the United States healthcare system (3). With the exception of non-specific lower back-pain, lumbar discopathy remains the most common cause of LBP (1, 4) and accounts for 90% of lumbar radiopathic pain (5). If conservative treatment options fail for lumbar disc herniation (LDH) and the patient's present indications for surgery such as, muscle weakness and bladder and/or bowel incontinence, lumbar discectomy may be employed (6).

Approximately 300 000 lumbar discectomies are performed each year in the USA, making lumbar discectomy the most performed neurological surgery in the country (6). The current "gold standard" of surgical technique for lumbar discectomy is generally agreed to be microdiscectomy also referred to as standard open microdiscectomy (6–9). Introduced to the USA in 1978 by Williams (9), the lumbar microdiscectomy procedure was and remains characterized by its utilization of an operating microscope to allow increased visualization with a decrease in incision size, blood loss and overall tissue dissection (4, 9–11).

Lumbar microdiscectomy, initially performed in the hospital setting, has become the first major spine surgery to transition into the ambulatory setting. This push to move surgeries from an inpatient setting to ambulatory setting offers faster recovery time and better postoperative outcomes (12–14). Various studies (6, 12–15) have stated that performing lumbar microdiscectomy in the outpatient setting can provide satisfactory outcomes but currently there is no study in the literature to the author's knowledge that analyses the incidence and location of surgery for lumbar microdiscectomy in a national sample. The purpose of this study was to report on the incidence of lumbar microdiscectomy in the USA over a recent seven-year period (2007–2014), the associated procedural reimbursement costs associated with the inpatient and the outpatient setting and the demographic distribution of the surgeries. We also, intended to compare the groups of patients, according to the location of surgery, inpatient *versus* outpatient as to better understand which factors might be directing patients to the outpatient setting.

SUBJECTS AND METHODS

We conducted a query of unidentified patient records within the PearlDiver Database (PearlDiver Inc, Warsaw, Indiana) for the years 2007 to 2014. The search was performed through the use of current procedural terminology (CPT) codes 63020, 63030 and 63035 and lumbar microdiscectomy. Data were

stratified to create two Groups according to where the surgery was performed. The first Group was that of those patients who underwent surgery in the inpatient setting and Group 2 those who were operated in the outpatient setting. The PearlDiver Database is a publicly available, Health Insurance Portability and Accountability Act (HIPAA) – compliant national database compiled from a collection of private insurer records. This query was performed within the Humana database, which holds more than two billion individual patients. The PearlDiver Supercomputer has been previously used in an array of studies and provides a national database for analysis of trends in healthcare (16–19).

In addition to CPT and the international classification of diseases – 9 (ICD-9) codes, demographic data such as, age and gender were also recorded and analysed. Kolmogorov-Smirnov testing was performed in order to analyse whether the age groups had a Gaussian distribution. Linear regression was utilized to compare the trends in lumbar microdisectomy from 2007 to 2014. Analysis of variance (ANOVA), Chi-square and the student *t*-tests were used where appropriate. An alpha value less than 0.05 was set as significant.

RESULTS

The database contains more than 56 million patient records. Within the study period, there were a total of 48 806 572 patients in the dataset available for scrutiny. Within the seven-year study period 38 636 lumbar discectomies were performed (Table 1). Of these, 20 884, were performed in the inpatient setting while 12 765 were completed in the outpatient setting ($p < 0.001$). The total number of procedures done in the inpatient setting did not change significantly from 2437 in 2007 to 2788 in 2014 ($p = 0.888$). In contrast, the total number of procedures done in the outpatient setting increased significantly from 906 in 2007 to 2647 in 2014 [$p = 0.015$] (Table 1).

Table 1: Annual lumbar discectomy

Year	LD	Inpatient	Outpatient
2007	3875	2437	906
2008	4408	2553	1132
2009	4419	2493	1363
2010	4599	2575	1530
2011	4634	2664	1400
2012	4884	2616	1669
2013	5518	2758	2118
2014	6299	2788	2647
Total	**38 636**	**20 884**	**12 765**
CAGR	**7.2%**	**1.9%**	**16.6%**

LD: Lumbar discectomy; CAGR: compound annual growth rate

There was significance noted between the groups as well, ($p < 0.001$). The numbers of procedures performed in each age range are presented in (Table 2).

Table 2: Lumbar discectomy distribution by age

Age (Years)	LD	Inpatient	Outpatient
20 to 24	382	149	185
25 to 29	660	243	332
30 to 34	1215	468	675
35 to 39	1598	654	818
40 to 44	2046	942	940
45 to 49	2610	1258	1131
50 to 54	3000	1526	1136
55 to 59	3333	1835	1095
60 to 64	3401	1922	1075
65 to 69	6777	4081	1749
70 to 74	5774	3454	1492
75 to 79	3422	2173	763
80 to 84	1640	1066	357
85 to 89	380	211	104
> 90	422	296	54

LD: Lumbar discectomy

The modal age range was 65–69 years with a total of 6777 (18%) cases, in the population. There were 10 609 females in the inpatient setting (58%) whereas, the outpatient setting had 5495 (42%). There was significant difference between genders (Table 3, $p < 0.001$).

Table 3: Lumbar discectomy distribution by gender

Gender	LD	Inpatient	Outpatient
Female	18 389	10 609	5495
Male	19 164	9825	7053
Total	**37 553**	**20 434**	**12 548**

LD: Lumbar discectomy

The regional distribution of the procedures is shown in Table 4. The South was the region where the majority of surgeries where performed in both settings.

Table 4: Lumbar discectomy distribution by region

Region	LD	Inpatient	Outpatient
Midwest	9923	5307	3526
Northeast	542	316	160
South	23 239	12 342	7988
West	3849	2469	874

LD: Lumbar discectomy

When comparing costs, the average reimbursement for lumbar discectomy began at $1746 in 2007 and ended at $2922 in 2014 (Table 5). The average reimbursement for inpatient lumbar microdiscectomy was $1005 in 2007 and decreased

to $718 in 2014 (Table 5). Conversely, for outpatient lumbar microdiscectomy, the average reimbursement began at $3245 in 2007 and increased to $5022 in 2014 (Table 5).

Table 5: Annual lumbar discectomy reimbursements

Year	LD		Inpatient		Outpatient	
2007	$1746	$6 765 750	$1005	$2 449 185	$3245	$2 939 970
2008	$1771	$7 806 568	$872	$2 226 216	$3518	$3 982 376
2009	$2014	$8 899 866	$828	$2 064 204	$3880	$5 288 440
2010	$2111	$9 708 489	$792	$2 039 400	$4026	$6 159 780
2011	$2190	$10 148 460	$796	$2 120 544	$4478	$6 269 200
2012	$2376	$11 604 384	$790	$2 066 640	$4433	$7 398 677
2013	$2645	$14 595 110	$677	$1 867 166	$4853	$10 278 654
2014	$2922	$18 405 678	$718	$2 001 784	$5022	$13 293 234
Average	**$2221.88**	**$10 991 788.13**	**$809.75**	**$2 104 392.38**	**$4181.88**	**$6 951 291.38**

LD: Lumbar discectomy

This demonstrated a statistical significance between the groups, $p < 0.001$. The seven-year mean reimbursement cost for lumbar microdiscectomy done in the inpatient setting was $809.75 compared to $4181.88 in the outpatient setting, which was statistically significant ($p = 0.027$).

Correlation analysis performed between reimbursements and number of procedures demonstrated significance in both groups, $R = -0.889$, $p = 0.003$, in the inpatient cohort and $R = 0.914$, $p = 0.002$ in the outpatient cohort.

DISCUSSION

The study aimed to determine the trend of lumbar microdiscectomy as it relates to the total number of procedures performed using a national database as well as the operative settings thereof. Overall, there was a statistical increase in the total number of procedures being performed in the outpatient setting. Based on analysis, the increase in number of procedures in the outpatient cohort is directly correlated to the increase of reimbursements. In the inpatient group, however, the stability of procedures being performed in the inpatient setting is correlated to a decrease in reimbursements. Several outcome studies have demonstrated the superiority of performing spine surgery in the outpatient setting (11–13, 20, 21). One such study, conducted by Zahrawi, reports an 88% satisfaction rate (out of 103 patients), as well as supports that lumbar microdiscectomy is safe and cost-effective in the outpatient setting (12). One major factor affecting the increased reimbursements for outpatient procedures is the decrease in expenditures related to patient hospital stay. A study by Lorish *et al*, assessing the correlation between hospital length of stay for lumbar microdiscectomy and how it relates to health outcomes, demonstrated a significant reduction of hospital charges between one and two-day patient stay [$781] (22).

In addition to decreased cost, reduce morbidity and mortality, have been the main reasons for the increase in the number of outpatient procedures being performed (23–25). In a prospective study of complication rates of outpatient cervical and lumbar microsurgeries, 99.8% of the 1449 patients were successfully discharged home the same day of the procedure (23).

A survey done by Kazberouk *et al* demonstrated that the volume of patients can be increased using an innovative payment plan based on cost-effective care (26). In the outpatient setting with cost-based care, there is an increased volume and therefore, an increased reimbursement model. Based on the paucity of data, this study has not only shown a significant increase in lumbar microdiscectomy being performed in a national sample but it is also correlates with increased reimbursements.

Limitations

This study is not without limitations. The PearlDiver Database is reliant upon accurate CPT or ICD coding which creates the potential for a reporting bias. There is also a potential of under-reporting as noted in the Northeast region and the total number of lumbar microdiscectomies performed annually does not correlate to the expected 300 000 per year (6).

Strengths

One of the strengths of this study is the use of a national database population. In addition, the study adds to the body of knowledge as it relates to outpatient lumbar microdiscectomy, as it investigates the rate of surgery incidence in the outpatient setting and associated cost reimbursement, which has not been adequately studied previously.

CONCLUSION

This study has demonstrated a significant increase in lumbar microdiscectomy performed in the outpatient setting. This is directly correlated to an increase in reimbursement cost. Conversely, inpatient lumbar microdiscectomy incidence showed stability with a negative direct correlation to cost reimbursement.

AUTHORS' NOTE

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