Spine Deformity
www.spine-deformity.org

Spine Deformity 4 (2016) 48–54

Cost-Effectiveness of Lumbar Spondylolisthesis Surgery at 2-Year Follow-up

Charla R. Fischer, MD[a,*], Ryan Cassilly, MD[a], Marc Dyrszka, MD[a], Yuriy Trimba, BS[b], Austin Peters, MD[b,c], Jeffrey A. Goldstein, MD[b], Jeffrey Spivak, MD[b], John A. Bendo, MD[b]

[a]*Columbia University Medical Center, 630 West 168th St, New York, NY 10032, USA*
[b]*NYU Hospital for Joint Diseases, 333 E 38th St, New York, NY 10016, USA*
[c]*Oregon Health and Sciences University, 3181 SW Sam Jackson Park Rd, Portland, OR 97239, USA*

Received 17 May 2014; revised 16 May 2015; accepted 23 May 2015

Abstract

Objectives: The purpose of this study was to determine the cost/quality-adjusted life-year (QALY) of the operative treatment of lumbar spondylolisthesis and identify factors associated with cost-effectiveness at 2 years.

Methods: We evaluated patients who underwent surgery for spondylolisthesis. The QALY was determined from the EQ5D. Outcomes were also assessed using the Oswestry Disability Index (ODI). Surgical, neuromonitoring, and anesthesia Current Procedural Terminology (CPT) codes as well as hospital Diagnosis-Related Group codes were used to determine the Medicare direct care costs of surgery. Indirect costs were modeled based on existing literature. A discounting rate of 3% was applied. Analysis was performed to determine which factors were associated with a cost/QALY less than $100,000.

Results: There were 44 patients who underwent surgery for either degenerative (30) or isthmic spondylolisthesis (14). There were 27 women and 17 men, with an average age at surgery of 59.7 years (standard deviation [SD] = 14.69) and an average follow-up of 2 years (SD = 0.82). The average postoperative improvement in ODI was 24.77 (SD = 23.9), and change in QALY was 0.43 (SD = 0.30). The average cost/QALY at 2 years for direct care costs was $89,065. The average cost/QALY at 2 years for direct plus indirect costs was $112,588. Higher preoperative leg pain and greater leg pain change was associated with a cost/QALY <$100,000 ($p < .005$, $p < .028$). The cost-effective group had a higher proportion of patients with disease extent of two or more levels ($p = .021$). When comparing surgical techniques of anterior-posterior and posterior only, there was no difference in cost-effectiveness.

Conclusions: Spondylolisthesis surgery is cost-effective at 2 years, with a QALY change of 0.43 and a direct cost/QALY of $89,065. Higher preoperative leg pain and larger extent of disease was associated with cost-effectiveness.

Level of Evidence: IV.

Keywords: Spondylolisthesis; Cost-effectiveness; Cost/QALY; Spinal fusion

Introduction

Spinal disorders affect a large percentage of the world population. It is estimated that approximately 11% of the population over the age of 18 has a spinal deformity [1-3], and more than 15% of the US population visits a physician for a complaint of low back pain every year [4]. As a result, spinal disorder–related complaints in the United States account for more than 40 million physician's office visits per year, amounting to large costs to the individual both through direct healthcare costs and indirect expenses such as time off from work and limitation of daily activities [5]. In 2009, hospitalization costs alone in the United States amounted to $3.3 billion [6]. Therefore, there is a significant need to

Portions of this manuscript were presented in abstract/podium form at the IMAST, Vancouver, British Columbia, Canada, July 10–13, 2013.

Author disclosures: CRF (none); RC (none); MD (none); YT (none); AP (none); Jeffrey A. Goldstein (reports personal fees from Medtronic, personal fees from NuVasive, and personal fees from K2M Medical, outside the submitted work); JS (reports personal fees from Titan Spine, outside the submitted work); JAB (none).

Institutional review board approval was obtained for this study.

No funding was received in support of this work.

*Corresponding author. Columbia University Medical Center, 622 West 168th Street, PH11-1154, New York, NY 10032, USA. Tel.: (212) 305-9192; fax: (212) 305-4040.

E-mail address: cdr2112@columbia.edu (C.R. Fischer).

2212-134X/$ - see front matter © 2016 Scoliosis Research Society.
http://dx.doi.org/10.1016/j.jspd.2015.05.006

evaluate the effectiveness of spine patient care, while maintaining individualized, patient-focused treatment to ensure excellent surgical outcomes.

Spondylolisthesis is anterior or posterior displacement of one vertebra relative to the vertebra directly below it. Whether it is the isthmic type or degenerative type, outcomes for surgical treatment have historically been good to excellent [3,7-22]. Although some forms of medical/interventional treatments have been shown to be effective, the Spine Patient Outcomes Research Trial (SPORT) has shown that, in general, surgical treatments are more cost-effective in the midterm [23]. It remains to be determined, however, whether there are certain patient types and surgical approaches that are more cost-effective than others.

The most widely accepted method of performing cost-effectiveness analysis is the quality adjusted life year (QALY) [24-27]. This outcome measure is a per-year assessment of the difference made by a treatment on a patient's length and quality of life, where 0 is death and 1 is the best imaginable health state. Whenever treatment causes QALY to improve, there is a benefit to that treatment which can be quantified. The cost of the treatment is divided by QALY gained giving a number called cost/QALY. Prior studies have shown that surgical interventions with a cost/QALY less than $100,000 are globally cost-effective [25-30].

The purpose of this study is to determine the cost/QALY of the surgical management of degenerative and isthmic lumbar spondylolisthesis treated with surgery and to identify preoperative and surgical factors that lead to cost-effectiveness at 2 years' follow-up.

Materials and Methods

Study design and inclusion criteria

After institutional review board approval was obtained, retrospective analysis was performed on data collected on a cohort of 44 patients who underwent surgery for isthmic or degenerative spondylolisthesis. These patients were part of a longitudinal outcomes database with prior institutional review board approval, and new approval was obtained for this study. Patients were included based on the following criteria: age greater than 18 years, a minimum follow-up of 2 years, and a diagnosis of degenerative or isthmic spondylolisthesis.

Data collection

The preoperative demographic characteristics reviewed included age, gender, prior surgery status, level of prior surgery, type of spondylolisthesis, number of affected segments, and number of fusion levels. The health-related quality of life (HRQOL) factors measured included Oswestry Disability Index (ODI), EuroQol (EQ-5D), visual analog scale (VAS), Back Pain score, and Leg Pain score. The HRQOL factors were measured preoperatively and at the final follow-up, and their difference was calculated. The specific surgical procedures were determined by the surgeon and include the following: anterior lumbar interbody fusion with posterior percutaneous pedicle screw stabilization (23), posterior lumbar interbody fusion with posterolateral fusion (8), and posterior lumbar fusion with posterolateral fusion (13). The surgical factors evaluated include anterior-posterior surgery or posterior only, posterior decompression performed or not performed, bone substitutes used, local complications, general complications, and whether revision surgery was performed during the follow-up period.

Cost determination and cost-effectiveness analysis

A Medicare model was used to determine the direct costs of surgery [27]. Hospital reimbursement values were calculated based on Diagnosis-Related Group codes. Physician reimbursement, including surgeon, anesthesia, and neuromonitoring costs, was based on Medicare Current Procedural Terminology code reimbursement rates. Indirect cost was calculated for patients under retirement age (65 years), average per capita income in New York State ($30,948) as reported by US Census data in 2010. The average time off from work after open transforaminal lumbar interbody fusion (17 weeks) was determined from a recent study by Parker et al. [31]. The indirect costs worked out to $10,115. Using the above figures, the equation used was ($30,948/year)/(52 weeks/year) = $595/week, then ($595/week) × 17 weeks = $10,115.

Cost of complications and revisions, of which there were nine, were included in this analysis using the same method to determine the direct costs of the surgery as stated above. A discount rate of 3% was applied [25,32,33].

Patient outcomes were measured using 2-year outcome scores from the EQ-5D and ODI. The 2-year change in EQ-5D utility was used to calculate QALY change as has been previously established in the literature [23,31,34-36]. There are multiple measures of QALY commonly used in the spine literature, and those include SF-6D, EQ-5D, and ODI. As EQ-5D is the only measure that does not require a conversion equation, this was chosen as the outcome measure in this study. The cost/QALY was then determined by dividing the total direct cost of the surgery by changes in QALY over a 2-year period. Finally, analysis was performed to determine which factors were associated with a cost/QALY less than $100,000, which was used as a cutoff for determining global cost-effectiveness [35].

Statistics

Statistical analysis was performed in SPSS, version 17, software (Chicago, IL), using analysis of variance, chi-square, and linear regression analysis. After calculating cost/QALY for each patient, the 44 patients were split into two groups with cost/QALY ranges of $<$$100,000, and