Quality-Adjusted Life Years in Spine Surgery

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INTRODUCTION: Spinal disorders such as degenerative disc disease, spinal stenosis, and disc herniation are major causes of chronic pain and disability worldwide. Surgical intervention often improves quality-adjusted life years (QALY) compared to conservative care, a key measure in cost-utility analysis. With rising spine surgery rates in the aging U.S. population, evaluating safety, economic value, and patient-reported outcomes is essential. While prior studies examined single levels, regions, or pathologies, variability in QALY across procedures and levels remains unclear. This retrospective study analyzed 1-year QALY changes after single- and multi-level cervical and lumbar fusions and decompressions at a single academic center.

METHODS: Patients who underwent single- or multi-level cervical or lumbar decompression or fusion surgeries, with completed preoperative and one-year follow-up PROMIS-GH questionnaires were included. Patients with prior spine surgery or additional surgeries within one year were excluded. Patients with surgical indications for malignancy, trauma, and infection were also excluded. QALYs were calculated by mapping PROMIS-GH scores to EQ-5D-3L index values and using a validated formula to determine the net gain in health-related quality of life postoperatively. Paired t-tests evaluated improvement within a surgical group. Between-group comparisons were assessed using one-way ANOVA and post hoc Tukey's tests. Linear regression was used to evaluate associations between baseline health states and postoperative improvements. This study was approved by an institutional review board (HS-23-00758).

RESULTS: 218 subjects were included in the final analysis; cervical decompressions (n=4) were excluded due to insufficient sample size. Of these, 98 (45%) were female and 120 (55%) were male. All surgical groups demonstrated significant 1-year improvements in QALYs and EQ-5D-3L scores. The largest gains were seen in 1-level lumbar fusion (QALY: 0.05±0.04, $p<0.001$) and 1-level lumbar decompression (QALY: 0.05±0.06, $p<0.001$), while the smallest were in multi-level cervical fusion (QALY: 0.02±0.04, $p<0.001$) and multi-level lumbar decompression (QALY: 0.02±0.05, $p=0.027$). ANOVA revealed significant overall between-group differences depending on type of surgery ($p = 0.035$). Negative outcome rates were highest in multi-level lumbar decompression (31.8%) and 1-level cervical fusion (29.4%), and lowest in 1-level lumbar fusion (5.9%) and decompression (18.0%). Regression analysis showed a significant negative association between baseline health status and postoperative improvements ($R= -0.338$, $p<0.001$).

DISCUSSION: Across all spine surgeries, QALYs improved significantly. The greatest gains and lowest negative outcome rates in single-level surgeries, while multi-level procedures showed smaller gains and higher negative outcomes, suggesting relatively greater responsiveness to treatment likely due to increased surgical complexity and disease burden. Lower baseline health states were associated with greater improvements, reflective of the ceiling effect described in prior literature and underscoring the influence of preoperative condition. Although QALYs were modest (range 0.02-0.05), such differences are clinically meaningful in the context of health economic evaluations where, over time, even small gains can influence cost-effectiveness and resource allocation decisions. These findings provide valuable insights into the comparative effectiveness of spine surgeries in cost-utility analyses and inform evidence-based clinical decision-making. Limitations include the retrospective design, mapped rather than direct EQ-5D-3L values, short follow-up, modest subgroup sizes, and lack of pathology-specific stratification.

SIGNIFICANCE: This study demonstrates that spine surgery provides measurable improvements in QALYs generated, with single-level procedures yielding the greatest benefit. By highlighting variation in outcomes across surgical types, these findings may guide surgical decision-making, outcome interpretation, and cost-effectiveness evaluations.

Table 1. Comparison of QALYs at Baseline and 1 Year Across Various Spine Surgeries

	(Mean ± SD)				Number (%)
Intervention	Baseline	1 Year	Difference	p-value (Baseline vs. 1 Year)	Negative Change
1-Level Cervical Fusion (n=17)	0.64 ± 0.09	0.67 ± 0.09	0.03 ± 0.05	0.016	5 (29.41)
Multi-Level Cervical Fusion (n=31)	0.62 ± 0.10	0.64 ± 0.10	0.02 ± 0.04	<0.001	8 (25.81)
1-Level Lumbar Fusion (n=34)	0.59 ± 0.08	0.65 ± 0.08	0.05 ± 0.04	<0.001	2 (5.88)
Multi-Level Lumbar Fusion (n=53)	0.57 ± 0.09	0.61 ± 0.08	0.04 ± 0.05	<0.001	12 (22.64)
1-Level Lumbar Decompression (n=61)	0.59 ± 0.09	0.64 ± 0.09	0.05 ± 0.06	<0.001	11 (18.03)
Mulit-Level Lumbar Decompression (n=22)	0.62 ± 0.10	0.64 ± 0.10	0.02 ± 0.05	0.027	7 (31.82)

Note: The $p < 0.05$ was considered as significant.