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Cost-utility analysis of anterior cervical discectomy and fusion versus cervical disc arthroplasty

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STUDY TYPE

Cost-utility analysis of patients contributed to a randomized controlled trial.

INTRODUCTION

Patients with cervical disc herniations resulting in radiculopathy or myelopathy from single-level disease have traditionally been treated with anterior cervical discectomy and fusion (ACDF) with excellent results. Cervical disc arthroplasty (CDA) has been shown to result in similar clinical outcomes. Expert suggestion of reduced adjacent segment degeneration is a promising future result. To our knowledge, a cost-utility analysis of these procedures with long-term follow-up has not been previously reported.

OBJECTIVES

To compare the cost-utility of ACDF versus CDA in single-level cervical disc disease. To structure future research of the cost-utility over a long-term follow-up for these alternative surgical options.

METHODS

We reviewed single institution prospective data from a randomized trial comparing single-level ACDF and CDA in cervical disc disease [1]. Data collected included demographics, Health-Related Quality of Life outcome scores (neck disability index [NDI] and SF-36), and quality-adjusted life year (QALY) utility scores. The QALYs were calculated at 1 and 2 years after surgery based on accepted methodology [2, 3] allowing for cost/QALY assessment. Procedural cost was estimated via Medicare reimbursement based on diagnosis related groups (DRG) and physician current procedural terminology (CPT) codes.

RESULTS

Patients included ACDF (n=10) and CDA (n=18) with no significant difference in demographic data (Table 1). Both groups showed improvement in NDI. Both groups showed improvement in all domains of SF-36 except general health, which remained stable. The ACDF patients recorded significantly higher scores in the mental health domain at 1 and 2 years ($P < .05$).

At 2 years, total QALYs gained were for ACDF, 0.37 and CDA, 0.27 when calculated using NDI; ACDF, 0.47 and CDA, 0.32 when using SF-36 (Table 2). The average cost of ACDF was \$16,162, while CDA averaged \$13,171. Cost/QALY was for ACDF, \$43,681 and CDA, \$48,781 at 2 years based on NDI. Cost/QALY was for ACDF, \$34,387 and CDA, \$41,159 at 2 years based on SF-36.

No conflict of interest.
IRB approved study NYU.
This device is FDA approved for the use evaluated in this study.

The incremental cost-effectiveness ratios of ACDF versus CDA were \$29,910 and \$19,940 when calculated with NDI and SF-36, respectively (**Table 3**).

CONCLUSIONS

We confirm the efficacy of ACDF and CDA in the treatment of cervical disc disease. Our results suggest similar clinical outcomes at 1- and 2-year follow-up. Both modalities dem-

onstrate cost-effectiveness. However, the additional QALYs gained by ACDF in this study demonstrate a potentially more cost-effective profile at 2 years. The incremental cost-effectiveness ratio suggests that the added benefit via ACDF comes at a reasonable cost.

Long-term follow-up may illustrate greater cost-effectiveness via CDA due to lower cost based on this financial model and potential economic treatment dominance over ACDF.

Table 1 Summary of demographics.*

| | ACDF (SD) | CDA (SD) | P value |
|----------------------|--------------|--------------|---------|
| No. of patients | 10 | 18 | - |
| Gender (M,F) | (6,4) | (9,9) | .71 |
| Age, y | 40.3 (6.5) | 41.89 (9.1) | .63 |
| Body mass index | 26.15 (4.0) | 26.94 (4.2) | .63 |
| ASA (1,2) | (1,9) | (3,15) | .55 |
| Operative time, min | 195.7 (24.5) | 204.8 (24.4) | .36 |
| Length of stay, days | 1.20 (0.42) | 1.38 (0.61) | .39 |
| Level operated | | | |
| - C4-5 | 0 | 2 | |
| - C5-6 | 7 | 10 | |
| - C6-7 | 3 | 6 | |

* ACDF indicates anterior cervical discectomy and fusion; CDA, cervical disc arthroplasty; SD, standard deviation; and ASA, American Society of Anesthesiologists physical status classification system.

Table 2 Summary of utility values.*

| | ACDF (SD) | CDA (SD) | P value |
|-----------------------|-------------|-------------|---------|
| NDI | | | |
| Preoperative utility | 0.49 (0.1) | 0.50 (0.1) | .66 |
| 6 mo | 0.69 (0.1) | 0.63 (0.12) | .13 |
| 12 mo | 0.61 (0.21) | 0.65 (0.12) | .56 |
| 18 mo | 0.69 (0.1) | 0.65 (0.12) | .29 |
| 24 mo | 0.70 (0.1) | 0.64 (0.11) | .11 |
| Total QALY 1 y | 0.16 (0.15) | 0.13 (0.11) | .57 |
| Total QALY 2 y | 0.37 (0.23) | 0.27 (0.2) | .27 |
| SF-36 | | | |
| Preoperative utility | 0.47 (0.1) | 0.51 (0.12) | .34 |
| 6 mo | 0.69 (0.13) | 0.66 (0.14) | .51 |
| 12 mo | 0.72 (0.13) | 0.68 (0.17) | .52 |
| 18 mo | 0.71 (0.11) | 0.69 (0.18) | .72 |
| 24 mo | 0.71 (0.13) | 0.68 (0.16) | .69 |
| Total QALY 1 y | 0.23 (0.16) | 0.15 (0.13) | .15 |
| Total QALY 2 y | 0.47 (0.30) | 0.32 (0.26) | .19 |

* NDI indicates neck disability index; ACDF, anterior cervical discectomy and fusion; CDA, cervical disc arthroplasty; SD, standard deviation; and QALY, quality-adjusted life year.

REFERENCES

1. **Murrey D, Janssen M, Delamarter R, et al** (2009) Results of the prospective, randomized, controlled multicenter Food and Drug Administration investigational device exemption study of the ProDisc-C total disc replacement versus anterior discectomy and fusion for the treatment of 1-level symptomatic cervical disc disease. *Spine J*; 9:275–286.
2. **Carreon LY, Anderson PA, McDonough CM, et al** (2010) Predicting SF-6D utility scores from the Neck Disability Index and Numeric Rating Scales for neck and arm pain. *Spine*; Epub ahead of print.
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Table 3 Procedure costs and cost-utility analysis.*

| | ACDF (SD) | CDA (SD) | P value |
|--------------------------------|--------------------|------------------|---------|
| Medicare Cost | | | |
| Hospital | \$11,747 (\$1,343) | \$10,015 (\$0) | 0.003 |
| Surgeon | \$3,107 (\$0) | \$1,826 (\$0) | 0.00 |
| Anesthesia | \$596 (\$37) | \$610 (\$37) | 0.94 |
| Neuromonitoring | \$710 (\$57) | \$720 (\$72) | 0.7 |
| Total Cost | \$16,162 (\$1,337) | \$13,171 (\$106) | 0.00 |
| Cost/QALY | | | |
| Cost/QALY – 1 y (NDI) | \$101,013 | \$101,315 | - |
| Cost/QALY – 2 y (NDI) | \$43,681 | \$48,781 | - |
| ICER ACDF vs CDA – 1 y (NDI) | \$99,700 | - | - |
| ICER ACDF vs CDA – 2 y (NDI) | \$29,910 | - | - |
| Cost/QALY (SF-36) | | | |
| Cost/QALY – 1 y (SF-36) | \$70,269 | \$87,806 | - |
| Cost/QALY – 2 y (SF-36) | \$34,387 | \$41,159 | - |
| ICER ACDF vs CDA – 1 y (SF-36) | \$37,387 | - | - |
| ICER ACDF vs CDA – 2 y (SF-36) | \$19,940 | - | - |

* ACDF indicates anterior cervical discectomy and fusion; CDA, cervical disc arthroplasty; SD, standard deviation; QALY, quality-adjusted life year; NDI, neck disability index; and ICER, incremental cost-effectiveness ratio.