Cost-effectiveness of a bone-anchored annular closure device versus conventional lumbar discectomy in treating lumbar disc herniations

# APPENDIX

1. *Calculation of Health-State-Specific Medication Costs*

Medication costs were calculated and incorporated as input parameters. Primary data was obtained from the RCT. However, a challenge was that medication prescriptions/use were only recorded during follow-up visits. Given that some intervals between visits were long (e.g. 12 months); it was unrealistic to assume that patients took all their prescribed meds during the entire duration. We therefore assumed, based on clinical experience, that only a portion of the days were actual medicated days. Specifically, for follow-up visits at 6-weeks and 3-months, we assumed complete compliance. During 3-month intervals between visits, we assumed 1.5 months of use. Similarly, for 6-month intervals, 2 months of use; for 12-month intervals, 3 months of use; and for unscheduled visit, the medications in use were assumed to be used in their entirety and renewed, depending on the timing of the unscheduled visit. Please see Table A1 below for further clarity.

Table A1. Interval-Specific Time with Pain Medication in Use

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| --- | --- | --- |
| Interval length | Interview time points | Assumed time with pain med in use |
| 6 week | "6 weeks", "3 months" | 6 week |
| 3 months | "6 months" | 1.5 months |
| 6 months | "12 months" | 2 months |
| 12 months | "24 months", "36 months", "48 months", "60 months" | 3 months |
| Unscheduled | N/A | 100% prior use and renewed use depending on the time of the visit |

Medication costs were extracted from the U.S. medication Redbook 2009 edition. We excluded medications that are unavailable in the U.S. We calculated costs based on the recommended frequency and standardized to a per-30-day cost. All costs were adjusted for inflation to 2017 dollars.

1. *Input Parameters: Productivity Loss*

Productivity loss was included in all scenarios analyzed from a societal perspective. Productivity loss data is directly sourced from the trial data. We found work status to be highly associated with the constructed health states – i.e., better health states equated to a higher likelihood of working with less restriction.

Work status was translated into percentage of work time. Each stratification: “work with no restriction”, “work with few restrictions”, “work with many restrictions”, and “unable to work” were associated with 100%, 70%, 30%, and 0% work time, respectively. We used 2016 U.S. national average annual wage data to calculate the productivity loss associated with symptomatic lumbar disk herniation patients.2

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| --- | --- | --- | --- | --- | --- |
| **Table A2. Distribution of Work Status by Health State** | | | | | |
|  | Mild | Moderate | Severe | Crippled | Bedbound |
| work with no restriction | 66.3% | 43.7% | 24.4% | 20.9% | 11.7% |
| work with few restrictions | 12.7% | 18.4% | 22.2% | 24.9% | 13.2% |
| work with many restrictions | 1.2% | 3.6% | 5.7% | 6.7% | 6.6% |
| unable to work | 6.0% | 16.2% | 25.3% | 23.1% | 45.7% |
| out of job /student /retired | 13.9% | 18.0% | 22.4% | 24.4% | 22.8% |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Table A3. Distribution of Work Status by Surgical Cohort** | | | | | | | | | |
| **Months since initial surgery** | **0** | **1.5** | **3** | **6** | **12** | **24** | **36** | **48** | **60** |
| **ACD** |  |  |  |  |  |  |  |  |  |
| work with no restriction | 12.8% | 42.3% | 47.8% | 49.7% | 52.7% | 53.4% | 54.7% | 54.0% | 55.5% |
| work with few restrictions | 14.6% | 17.1% | 16.4% | 16.1% | 15.5% | 15.9% | 15.5% | 16.1% | 14.8% |
| work with many restrictions | 6.6% | 3.8% | 3.2% | 3.0% | 2.7% | 3.0% | 2.8% | 3.1% | 2.3% |
| unable to work | 42.9% | 18.4% | 15.1% | 14.1% | 12.6% | 11.9% | 11.2% | 11.4% | 11.5% |
| out of job /student /retired | 23.0% | 18.5% | 17.5% | 17.2% | 16.6% | 15.8% | 15.8% | 15.3% | 15.9% |
| **Control** |  |  |  |  |  |  |  |  |  |
| work with no restriction | 13.2% | 41.9% | 47.1% | 49.1% | 49.2% | 49.5% | 48.2% | 46.6% | 48.2% |
| work with few restrictions | 15.2% | 17.2% | 16.7% | 16.2% | 15.8% | 16.0% | 16.4% | 16.5% | 16.5% |
| work with many restrictions | 6.6% | 3.8% | 3.3% | 3.1% | 3.0% | 3.0% | 3.2% | 3.3% | 3.2% |
| unable to work | 41.9% | 18.4% | 15.3% | 14.4% | 14.8% | 14.4% | 14.7% | 15.8% | 14.6% |
| out of job /student /retired | 23.1% | 18.6% | 17.7% | 17.3% | 17.2% | 17.2% | 17.5% | 17.7% | 17.5% |

*3. Transition Probabilities between Health States*

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| --- | --- | --- | --- | --- | --- | --- | --- |
| **Table A4. Time-Specific Transition Probabilities between Health States** | | | | | | | |
| **Transit from health state** | **Time range** | **Transit to health state** | | | | | **Markov**  **Cycle**  **Length** |
| **Mild** | **Moderate** | **Severe** | **Crippled** | **Bedbound** |
| **I. Discectomy with annular closure** | | | | |  |  |  |
| **Mild** | 0-6wk | - | - | - | - | - | 6wk |
| 6wk-6mo | 89.0 (85.6, 92.4) | 9.4 (6.2, 12.6) | 0.6 (0, 1.4) | 0.9 (0, 1.9) | 0.0 (0.0, 0.7) | 6wk |
| 6mo-1yr | 83.6 (77.5, 89.7) | 11.4 (6.1, 16.7) | 2.9 (0.1, 5.7) | 1.4 (0, 3.3) | 0.7 (0, 2.1) | 6mo |
| 1-2yr | 91.2 (87.9, 94.5) | 7.8 (4.7, 10.9) | 1.1 (0, 2.3) | 0.0 (0.0, 0.8) | 0.0 (0.0, 0.8) | 6mo |
| >2yr | 90.9 (87.9, 93.9) | 7.7 (4.9, 10.5) | 1.1 (0.0, 2.2) | 0.3 (0, 0.9) | 0.0 (0.0, 0.7) | 6mo |
| **Moderate** | 0-6wk | - | - | - | - | - | 6wk |
| 6wk-6mo | 32.7 (26.4, 39.0) | 53.1 (46.4, 59.8) | 10.9 (6.7, 15.1) | 2.8 (0.6, 5.0) | 0.5 (0, 1.5) | 6wk |
| 6mo-1yr | 56.9 (43.3, 70.5) | 23.5 (11.9, 35.1) | 11.8 (2.9, 20.7) | 5.9 (0, 12.4) | 2.0 (0, 5.8) | 6mo |
| 1-2yr | 9.9 (4.1, 15.7) | 79.2 (71.3, 87.1) | 10.9 (4.8, 17.0) | 0.0 (0.0, 2.4) | 0.0 (0.0, 2.4) | 6mo |
| >2yr | 20.9 (14.0, 27.8) | 65.7 (57.7, 73.7) | 11.2 (5.9, 16.5) | 2.2 (0, 4.7) | 0.0 (0.0, 1.8) | 6mo |
| **Severe** | 0-6wk | - | - | - | - | - | 6wk |
| 6wk-6mo | 12.8 (6.7, 18.9) | 33.3 (24.8, 41.8) | 36.8 (28.1, 45.5) | 12.8 (6.7, 18.9) | 4.3 (0.6, 8.0) | 6wk |
| 6mo-1yr | 20.0 (6.7, 33.3) | 34.3 (18.6, 50.0) | 28.6 (13.6, 43.6) | 14.3 (2.7, 25.9) | 2.9 (0, 8.5) | 6mo |
| 1-2yr | 0.0 (0.0, 4.0) | 11.9 (3.6, 20.2) | 72.9 (61.6, 84.2) | 11.9 (3.6, 20.2) | 3.4 (0, 8.0) | 6mo |
| >2yr | 9.6 (2.8, 16.4) | 13.7 (5.8, 21.6) | 52.1 (40.6, 63.6) | 19.2 (10.2, 28.2) | 5.5 (0.3, 10.7) | 6mo |
| **Crippled** | 0-6wk | 30.3 (14.6, 46.0) | 33.3 (17.2, 49.4) | 18.2 (5.0, 31.4) | 9.1 (0, 18.9) | 9.1 (0, 18.9) | 6wk |
| 6wk-6mo | 0.0 (0.0, 2.8) | 11.9 (5.0, 18.8) | 26.2 (16.8, 35.6) | 50.0 (39.3, 60.7) | 11.9 (5.0, 18.8) | 6wk |
| 6mo-1yr | 23.8 (5.6, 42.0) | 9.5 (0, 22.0) | 23.8 (5.6, 42.0) | 33.3 (13.1, 53.5) | 9.5 (0, 22.0) | 6mo |
| 1-2yr | 0.0 (0.0, 5.4) | 0.0 (0.0, 5.4) | 9.1 (0.6, 17.6) | 88.6 (79.2, 98.0) | 2.3 (0, 6.7) | 6mo |
| >2yr | 0.0 (0.0, 3.8) | 6.4 (0.4, 12.4) | 19.1 (9.4, 28.8) | 60.3 (48.2, 72.4) | 14.3 (5.7, 22.9) | 6mo |
| **Bedbound** | 0-6wk | 34.6 (28.5, 40.7) | 25.5 (19.9, 31.1) | 19.5 (14.4, 24.6) | 8.2 (4.7, 11.7) | 12.1 (7.9, 16.3) | 6wk |
| 6wk-6mo | 3.5 (0, 8.2) | 1.7 (0, 5.0) | 19.0 (8.9, 29.1) | 32.8 (20.7, 44.9) | 43.1 (30.4, 55.8) | 6wk |
| 6mo-1yr | 0.0 (0.0, 18.3) | 15.4 (0, 35.0) | 15.4 (0, 35.0) | 23.1 (0.2, 46.0) | 46.2 (19.1, 73.3) | 6mo |
| 1-2yr | 0.0 (0.0, 15.9) | 0.0 (0.0, 15.9) | 0.0 (0.0, 15.9) | 20.6 (0.1, 41.1) | 79.4 (58.9, 99.9) | 6mo |
| >2yr | 0.0 (0.0, 11.9) | 0.0 (0.0, 11.9) | 10.0 (0, 23.1) | 10.0 (0, 23.1) | 80.0 (62.5, 97.5) | 6mo |
|  | | |  |  |  |  |  |
| **II. Discectomy without annular closure** | | | | |  |  |  |
| **Mild** | 0-6wk | - | - | - | - | - | 6wk |
| 6wk-6mo | 87.9 (84.3, 91.5) | 9.0 (5.8, 12.2) | 3.2 (1.3, 5.1) | 0.0 (0.0, 0.8) | 0.0 (0.0, 0.8) | 6wk |
| 6mo-1yr | 76.0 (69.1, 82.9) | 17.8 (11.6, 24.0) | 3.4 (0.5, 6.3) | 1.4 (0, 3.3) | 1.4 (0, 3.3) | 6mo |
| 1-2yr | 91.1 (87.5, 94.7) | 8.1 (4.7, 11.5) | 0.8 (0, 1.9) | 0.0 (0.0, 1.0) | 0.0 (0.0, 1.0) | 6mo |
| >2yr | 85.4 (81.3, 89.5) | 11.7 (7.9, 15.5) | 2.5 (0.7, 4.3) | 0.4 (0, 1.1) | 0.0 (0.0, 0.8) | 6mo |
| **Moderate** | 0-6wk | - | - | - | - | - | 6wk |
| 6wk-6mo | 35.4 (29.0, 41.8) | 46.7 (40.0, 53.4) | 15.1 (10.3, 19.9) | 2.4 (0.3, 4.5) | 0.5 (0, 1.4) | 6wk |
| 6mo-1yr | 34.9 (20.7, 49.1) | 37.2 (22.8, 51.6) | 18.6 (7.0, 30.2) | 7.0 (0, 14.6) | 2.3 (0, 6.8) | 6mo |
| 1-2yr | 7.8 (3.2, 12.4) | 86.7 (80.8, 92.6) | 3.9 (0.5, 7.3) | 1.6 (0, 3.8) | 0.0 (0.0, 1.9) | 6mo |
| >2yr | 17.7 (12.2, 23.2) | 63.6 (56.7, 70.5) | 15.0 (9.9, 20.1) | 3.7 (1.0, 6.4) | 0.0 (0.0, 1.3) | 6mo |
| **Severe** | 0-6wk | - | - | - | - | - | 6wk |
| 6wk-6mo | 13.0 (7.7, 18.3) | 31.2 (23.9, 38.5) | 42.9 (35.1, 50.7) | 10.4 (5.6, 15.2) | 2.6 (0.1, 5.1) | 6wk |
| 6mo-1yr | 22.2 (8.6, 35.8) | 25.0 (10.9, 39.1) | 36.1 (20.4, 51.8) | 8.3 (0, 17.3) | 8.3 (0, 17.3) | 6mo |
| 1-2yr | 1.4 (0, 4.1) | 10.8 (3.7, 17.9) | 82.4 (73.7, 91.1) | 4.1 (0, 8.6) | 1.4 (0, 4.1) | 6mo |
| >2yr | 11.9 (6.1, 17.7) | 15.3 (8.8, 21.8) | 54.2 (45.2, 63.2) | 17.8 (10.9, 24.7) | 0.9 (0, 2.6) | 6mo |
| **Crippled** | 0-6wk | 51.1 (36.8, 65.4) | 23.4 (11.3, 35.5) | 8.5 (0.5, 16.5) | 8.5 (0.5, 16.5) | 8.5 (0.5, 16.5) | 6wk |
| 6wk-6mo | 1.3 (0, 3.8) | 1.3 (0, 3.8) | 33.8 (23.2, 44.4) | 53.3 (42.2, 64.4) | 10.4 (3.6, 17.2) | 6wk |
| 6mo-1yr | 23.1 (6.9, 39.3) | 15.4 (1.5, 29.3) | 26.9 (9.9, 43.9) | 11.5 (0, 23.8) | 23.1 (6.9, 39.3) | 6mo |
| 1-2yr | 0.0 (0.0, 7.9) | 0.0 (0.0, 7.9) | 26.7 (10.9, 42.5) | 66.7 (49.8, 83.6) | 6.7 (0, 15.6) | 6mo |
| >2yr | 5.3 (0, 11.1) | 7.0 (0.4, 13.6) | 15.8 (6.3, 25.3) | 56.1 (43.2, 69.0) | 15.8 (6.3, 25.3) | 6mo |
| **Bedbound** | 0-6wk | 28.3 (22.5, 34.1) | 29.2 (23.4, 35.0) | 20.2 (15.0, 25.4) | 10.3 (6.4, 14.2) | 12.0 (7.8, 16.2) | 6wk |
| 6wk-6mo | 1.6 (0, 4.7) | 6.3 (0.3, 12.3) | 12.5 (4.4, 20.6) | 21.9 (11.8, 32.0) | 57.8 (45.7, 69.9) | 6wk |
| 6mo-1yr | 0.0 (0.0, 14.0) | 5.9 (0, 17.1) | 11.8 (0, 27.1) | 23.5 (3.3, 43.7) | 58.8 (35.4, 82.2) | 6mo |
| 1-2yr | 0.0 (0.0, 7.0) | 0.0 (0.0, 7.0) | 0.0 (0.0, 7.0) | 20.6 (7.0, 34.2) | 79.4 (65.8, 93.0) | 6mo |
| >2yr | 0.0 (0.0, 7.7) | 0.0 (0.0, 7.7) | 3.2 (0, 9.4) | 19.4 (5.5, 33.3) | 77.4 (62.7, 92.1) | 6mo |