Supplementary Online Content

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This supplementary material has been provided by the authors to give readers additional information about their work.
### eTable 1: Radiologic evaluations of the MRIs

| Variable                   | Decompression alone | Fusion | p-value |
|----------------------------|---------------------|--------|---------|
| No. of patients            | 256                 | 72     |         |
| Stenosis levels*           |                     |        |         |
| L1/L2                      | 58 (22.7)           | 8 (11.1)| 0.046   |
| L2/L3                      | 130 (50.8)          | 26 (36.1)| 0.039   |
| L3/L4                      | 201 (78.5)          | 39 (54.2)| <0.001  |
| L4/L5                      | 228 (89.1)          | 63 (87.5)| 0.873   |
| L5/S1                      | 109 (42.6)          | 28 (38.9)| 0.670   |
| Stenotic levels*           |                     |        | 0.010   |
| 0                          | 2 (0.8)             | 1 (1.4)   |         |
| 1                          | 32 (12.5)           | 20 (27.8)|         |
| 2                          | 68 (26.6)           | 20 (27.8)|         |
| ≥3                         | 154 (60.2)          | 31 (43.1)|         |
| Spondylolisthesisb, n levels (%) |       |        |         |
| L1/L2                      | 10 (3.9)            | 3 (4.2)   | 1       |
| L2/L3                      | 19 (7.4)            | 5 (6.9)   | 1       |
| L3/L4                      | 50 (19.5)           | 15 (20.8)| 0.938   |
| L4/L5                      | 95 (37.1)           | 45 (62.5)| <0.001  |
| L5/S1                      | 46 (18.0)           | 16 (22.2)| 0.520   |

* at least one moderate grading in one of the following core parameters: compromise of the central zone, relation between fluid and cauda equina (Schizas classification), and nerve root compression in the lateral recesses

b Meyerding lischthesis grade ≥1
### eTable 2: Cumulative incidence of revisions and 95% confidence intervals, including only patients with degenerative spondylolisthesis

| Time after index operation | Decompression alone | Fusion |
|----------------------------|---------------------|--------|
|                             | Cumulative incidence, % (95% CI)<sup>a</sup> | No. at risk / of revisions<sup>b</sup> | Cumulative incidence, % (95% CI)<sup>a</sup> | No. at risk / of revisions<sup>b</sup> | Absolute risk difference, % (95% CI)<sup>a</sup> | Adj. absolute risk difference, % (95% CI)<sup>c,d</sup> | P value<sup>c</sup> |
| at index operation          | n.a. (n.a.)         | 146 / 0 | n.a. (n.a.)         | 57 / 0 | n.a. (n.a.)         | n.a. (n.a.)         | n.a. |
| 1 year                      | 6.2 (2.2-10.0)      | 137 / 9 | 1.8 (0.0-5.1)       | 56 / 1 | -4.4 (-9.6-0.8)    | 1.1 (-5.2-10.0)    | 0.763 |
| 2 years                     | 9.6 (4.7-14.2)      | 132 / 14| 10.5 (2.2-18.1)     | 51 / 6 | 0.9 (-8.4-10.2)    | 2.1 (-8.9-16.8)    | 0.750 |
| 3 years                     | 11.0 (5.7-15.9)     | 26 / 16 | 10.5 (2.2-18.1)     | 8 / 6  | -0.5 (-9.9-9.0)    | 2.3 (-9.7-18.0)    | 0.747 |

**Abbreviations:** adj., adjusted; CI, confidence interval

<sup>a</sup> Unadjusted estimates.

<sup>b</sup> Cumulative numbers of revisions.

<sup>c</sup> From fully adjusted multivariate Cox proportional hazards regression model (using the variables age, sex, body mass index (BMI) (&gt;25 kg/m2), current smoker, civil risk (living alone, or living in a nursing/residential home while being single, divorced, or widowed), duration of symptoms (&gt;6 months), cumulative illness rating scale (CIRS), depression (Hospital Anxiety and Depression Scale (HADS) depression subscale &gt;8 points), anxiety (HADS anxiety subscale &gt;8 points), degenerative spondylolisthesis (Meyerding grade ≥I), stenotic levels (&gt;1 stenotic level), and number of decompressed levels).

<sup>d</sup> The 95% CIs were obtained by the adjusted bootstrap percentile method from 2000 bootstrap iterations.
## eTable 3: Multivariable Cox proportional hazards regression model

| Covariate                                           | Hazard ratio (95% CI) | P value |
|-----------------------------------------------------|-----------------------|---------|
| Fusion (type of index operation)                    | 1.40 (0.63-3.13)      | 0.409   |
| Age (centered)                                      | 0.98 (0.94-1.02)      | 0.377   |
| Female                                              | 0.82 (0.39-1.70)      | 0.593   |
| BMI (≥25kg/m2)                                      | 1.18 (0.56-2.53)      | 0.662   |
| Civil risk<sup>a</sup>                              | 0.90 (0.41-1.98)      | 0.788   |
| Current smoker                                      | 0.65 (0.24-1.76)      | 0.395   |
| Duration of symptoms (>6 months)                   | 0.45 (0.22-0.91)      | **0.026** |
| CIRS (centered)                                     | 1.04 (0.95-1.14)      | 0.418   |
| Depression                                          | 2.32 (1.02-5.29)      | **0.046** |
| Anxiety                                             | 1.62 (0.73-3.61)      | 0.236   |
| Degenerative spondylolisthesis (Meyerding Grade ≥I) | 0.77 (0.39-1.51)      | 0.446   |
| Number of stenotic levels (>1 level)                | 0.92 (0.34-2.49)      | 0.863   |
| 2 Decompressed levels                               | 1.48 (0.65-3.37)      | 0.355   |
| 3 Decompressed levels                               | 1.82 (0.71-4.67)      | 0.214   |

Overall tests: likelihood ratio test p=0.09

Abbreviations: BMI, body mass index; CI, confidence interval; CIRS, Cumulative Illness Rating Scale

<sup>a</sup> Living alone, or single/divorced/widowed and living in a nursing/residential home
**eTable 4: Mixed-effects models for the outcomes SSM symptoms, SSM function, and EQ-5D-3L SI**

**A) SSM symptoms**

|                                | Estimate | Lower 95% CI | Upper 95% CI | p-value |
|--------------------------------|----------|--------------|--------------|---------|
| (Intercept)                    | 2.731    | 2.497        | 2.965        | 0.000   |
| Cumulative number of total operations | 0.171    | 0.047        | 0.295        | 0.007   |
| Fusion (type of index operation) | -0.1     | -0.258       | 0.057        | 0.214   |
| Age (centered)                 | 0.007    | -0.002       | 0.015        | 0.112   |
| Female                         | 0.227    | 0.089        | 0.364        | 0.001   |
| BMI (≥25kg/m²)                 | 0.185    | 0.054        | 0.315        | 0.006   |
| Civil risk                     | 0.023    | -0.169       | 0.124        | 0.760   |
| Duration of symptoms (>6 months) | 0.129    | -0.02        | 0.277        | 0.090   |
| CIRS (centered)                | 0.031    | 0.015        | 0.048        | 0.000   |
| Current smoker                 | 0.08     | -0.092       | 0.253        | 0.364   |
| Depression (≥8 points)         | 0.367    | 0.184        | 0.55         | 0.000   |
| Anxiety (≥8 points)            | 0.189    | 0.018        | 0.36         | 0.031   |
| Degenerative spondylolisthesis (Meyerding Grade ≥1) | -0.067 | -0.198 | 0.063 | 0.312 |
| Number of stenotic levels (>1 level) | 0.03 | -0.149 | 0.21 | 0.742 |
| 2 decompressed levels          | -0.026   | -0.169       | 0.116        | 0.716   |
| 3 decompressed levels          | 0.04     | -0.146       | 0.225        | 0.677   |
| Follow-up 12 months            | -1.216   | -1.367       | -1.064       | 0.000   |
| Follow-up 24 months            | -1.203   | -1.361       | -1.044       | 0.000   |
| Follow-up 36 months            | -1.21    | -1.372       | -1.048       | 0.000   |
### B) SSM function

|                          | Estimate | Lower 95% CI | Upper 95% CI | p-value |
|--------------------------|----------|--------------|--------------|---------|
| (Intercept)              | 2.037    | 1.848        | 2.226        | 0.000   |
| Cumulative number of total operations | 0.068    | -0.036       | 0.172        | 0.198   |
| Fusion (type of index operation) | -0.125   | -0.252       | 0.002        | 0.055   |
| Age (centered)           | 0.007    | 0.001        | 0.014        | 0.032   |
| Female                   | 0.213    | 0.102        | 0.324        | 0.000   |
| BMI (≥25kg/m²)           | 0.192    | 0.088        | 0.297        | 0.000   |
| Civil risk               | -0.03    | -0.148       | 0.088        | 0.624   |
| Duration of symptoms (>6 months) | 0.002    | -0.117       | 0.122        | 0.970   |
| CIRS                     | 0.016    | 0.003        | 0.03         | 0.015   |
| Current smoker           | 0.055    | -0.084       | 0.194        | 0.440   |
| Depression (≥8 points)   | 0.399    | 0.251        | 0.546        | 0.000   |
| Anxiety (≥8 points)      | 0.025    | -0.112       | 0.163        | 0.718   |
| Degenerative spondylolisthesis (Meyerding Grade ≥I) | -0.061 | -0.166 | 0.044 | 0.258 |
| Number of stenotic levels (>1 level) | -0.046 | -0.19 | 0.099 | 0.536 |
| 2 decompressed levels    | 0.007    | -0.108       | 0.122        | 0.908   |
| 3 decompressed levels    | 0.012    | -0.138       | 0.161        | 0.878   |
| Follow-up 12 months      | -0.816   | -0.944       | -0.689       | 0.000   |
| Follow-up 24 months      | -0.798   | -0.931       | -0.665       | 0.000   |
| Follow-up 36 months      | -0.774   | -0.91        | -0.638       | 0.000   |
### C) EQ-5D-3L SI

|                                | Estimate | Lower 95% CI | Upper 95% CI | p-value |
|--------------------------------|----------|--------------|--------------|---------|
| (Intercept)                    | 0.628    | 0.554        | 0.703        | 0.000   |
| Cumulative number of total operations | -0.061  | -0.105       | -0.017       | 0.007   |
| Fusion (type of index operation) | 0.029    | -0.021       | 0.079        | 0.251   |
| Age (centered)                 | -0.001   | -0.004       | 0.001        | 0.321   |
| Female                         | -0.098   | -0.142       | -0.055       | 0.000   |
| BMI (≥25kg/m²)                 | -0.062   | -0.103       | -0.02        | 0.004   |
| Civil risk                     | 0.047    | 0.001        | 0.094        | 0.046   |
| Duration of symptoms (>6 months) | -0.02   | -0.067       | 0.027        | 0.396   |
| CIRS                           | -0.01    | -0.015       | -0.005       | 0.000   |
| Current smoker                 | -0.023   | -0.078       | 0.032        | 0.413   |
| Depression (≥8 points)         | -0.172   | -0.23        | -0.114       | 0.000   |
| Anxiety (≥8 points)            | -0.031   | -0.085       | 0.023        | 0.258   |
| Degenerative spondylolisthesis (Meyerding Grade ≥1) | 0.036 | -0.006       | 0.077        | 0.093   |
| Number of stenotic levels (>1 level) | -0.012 | -0.069       | 0.045        | 0.677   |
| 2 decompressed levels          | -0.006   | -0.051       | 0.039        | 0.805   |
| 3 decompressed levels          | -0.037   | -0.096       | 0.021        | 0.213   |
| Follow-up 12 months            | 0.334    | 0.279        | 0.389        | 0.000   |
| Follow-up 24 months            | 0.329    | 0.272        | 0.386        | 0.000   |
| Follow-up 36 months            | 0.316    | 0.258        | 0.375        | 0.000   |
**eTable 5: Sensitivity analysis: baseline characteristics of the included patients**

| Variable                        | All               | Decompression alone | Fusion       | p-value  |
|--------------------------------|-------------------|---------------------|--------------|----------|
| No. of patients                | 396 (No (%))      | 309 (No (%))        | 87 (No (%))  |          |
| Age, years, median (IQR)       | 74.0 [67.0, 79.0]  | 75.0 [68.0, 80.0]   | 70.0 [64.0, 74.0] | <0.001  |
| Female                         | 200 (50.5)        | 157 (50.8)          | 43 (49.4)    | 0.915    |
| BMI, kg/m², median (IQR)       | 26.7 [24.0, 30.0]  | 26.4 [24.0, 30.2]   | 27.4 [24.0, 28.7] | 0.605    |
| BMI ≥25, kg/m²                 | 263 (66.4)        | 202 (65.4)          | 61 (70.1)    | 0.485    |
| Civil Risk<sup>a</sup>         | 134 (33.8)        | 112 (36.2)          | 22 (25.3)    | 0.075    |
| Compulsory education           | 102 (25.8)        | 84 (27.2)           | 18 (20.7)    | 0.278    |
| CIRS, median (IQR)             | 9.0 [7.0, 12.0]    | 9.0 [7.0, 12.0]     | 8.0 [6.0, 11.5] | 0.039    |
| Diabetes mellitus              | 41 (10.4)         | 37 (12.0)           | 4 (4.6)      | 0.073    |
| Current smoker                 | 58 (14.6)         | 40 (12.9)           | 18 (20.7)    | 0.102    |
| Back pain                      | 340 (85.9)        | 263 (85.1)          | 77 (88.5)    | 0.530    |
| Buttocks pain                  | 308 (77.8)        | 243 (78.6)          | 65 (74.7)    | 0.527    |
| Leg pain                       | 359 (90.7)        | 284 (91.9)          | 75 (86.2)    | 0.160    |
| Problem getting better or worse in the last 3 months | | | | 0.218 |
| Getting better                 | 23 (5.8)          | 21 (6.8)            | 2 (2.3)      |          |
| Staying about the same         | 63 (15.9)         | 52 (16.8)           | 11 (12.6)    |          |
| Getting worse                  | 308 (77.8)        | 234 (75.7)          | 74 (85.1)    |          |
| Don’t know                     | 2 (0.5)           | 2 (0.6)             | 0 (0.0)      |          |
| Duration of symptoms >6 months | 299 (75.5)        | 226 (73.1)          | 73 (83.9)    | 0.055    |
| HADS depression (≥8 points)    | 70 (17.7)         | 59 (19.1)           | 11 (12.6)    | 0.217    |
| HADS anxiety (≥8 points)       | 80 (20.2)         | 55 (17.8)           | 25 (28.7)    | 0.036    |
| SSM symptoms, median (IQR)<sup>b</sup> | 3.1 [2.7, 3.6]   | 3.1 [2.7, 3.6]      | 3.1 [2.8, 3.4] | 0.893    |
| SSM function, median (IQR)<sup>c</sup> | 2.2 [1.8, 2.8]  | 2.2 [1.8, 2.8]      | 2.2 [1.8, 2.6] | 0.141    |
| EQ-5D-3L St, median (IQR)<sup>d</sup> | 0.6 [0.2, 0.7]  | 0.6 [0.2, 0.7]      | 0.6 [0.4, 0.7] | 0.979    |

Abbreviations: BMI, body mass index; CIRS, Cumulative Illness Rating Scale; IQR, interquartile range

<sup>a</sup> Living alone, or single/divorced/widowed and living in a nursing/residential home.

<sup>b</sup> Score range 1-4 (best-worst); higher scores indicate more pain.

<sup>c</sup> Score range 1-5 (best-worst); higher scores indicate more disability.

<sup>d</sup> Score range 0.53-1.00 (worst-best); higher scores indicate better quality of life.
### eTable 6: Sensitivity analysis: cumulative incidence of revisions and 95% confidence intervals

| Time after index operation | Decompression alone | Fusion |  | Absolute risk difference, % (95% CI) | Adj. absolute risk difference, % (95% CI) | P value<sup>c</sup> |
|-----------------------------|---------------------|--------|-----------------------------|-------------------------------------------|------------------------------------------|
|                             | Cumulative incidence, % (95% CI)<sup>a</sup> | No. at risk / of revisions<sup>b</sup> | Cumulative incidence, % (95% CI)<sup>a</sup> | No. at risk / of revisions<sup>b</sup> |                                         |                           |
| at index operation          | n.a. (n.a.)         | 309 / 0 | n.a. (n.a.)                 | 87 / 0                                   | n.a. (n.a.)                              | n.a. (n.a.)                              | n.a. |
| 1 year                      | 5.1 (2.5-7.5)       | 269 / 15| 3.6 (0.0-7.5)               | 79 / 3                                   | -1.5 (-6.1-3.2)                          | 2.5 (-1.4-9.4)                          | 0.335 |
| 2 years                     | 8.7 (5.4-11.8)      | 243 / 25| 9.7 (3.1-15.9)              | 70 / 8                                   | 1.0 (-6.0-8.2)                           | 4.5 (-2.6-15.4)                         | 0.316 |
| 3 years                     | 10.9 (7.2-14.5)     | 46 / 31 | 13.7 (5.8-20.9)             | 10 / 11                                  | 2.8 (-5.4-11.1)                          | 5.7 (-3.2-18.5)                         | 0.305 |

Abbreviations: adj., adjusted; CI, confidence interval

In the sensitivity analysis also the patients without a complete follow-up of three years were included in the analysis (see Figure 1), i.e., "no longer interested" (n = 39), "died" (n = 16), "excluded by study nurse" (n = 11), "referred to assisted living residences" (n = 2).

<sup>a</sup> Unadjusted estimates.

<sup>b</sup> Cumulative numbers of revisions.

<sup>c</sup> From fully adjusted multivariate Cox proportional hazards regression model (using the variables age, sex, body mass index (BMI) (≥25 kg/m²), current smoker, civil risk (living alone, or living in a nursing/residential home while being single, divorced, or widowed), duration of symptoms (>6 months), cumulative illness rating scale (CIRS), depression (Hospital Anxiety and Depression Scale (HADS) depression subscale ≥8 points), anxiety (HADS anxiety subscale ≥8 points), degenerative spondylolisthesis (Meyerding grade ≥I), stenotic levels (>1 stenotic level), and number of decompressed levels).

<sup>d</sup> The 95% CIs were obtained by the adjusted bootstrap percentile method from 2000 bootstrap iterations.
eTable 7: Sensitivity analysis: multivariable Cox proportional hazards regression model

| Covariate                                                                 | Hazard ratio (95% CI) | p-value |
|---------------------------------------------------------------------------|------------------------|---------|
| Fusion (type of index operation)                                          | 1.62 (0.76-3.46)       | 0.213   |
| Age (centered)                                                            | 0.99 (0.95-1.03)       | 0.592   |
| Female                                                                    | 0.83 (0.41-1.67)       | 0.593   |
| BMI (≥25kg/m2)                                                            | 1.04 (0.51-2.12)       | 0.915   |
| Civil risk<sup>a</sup>                                                    | 0.93 (0.44-1.95)       | 0.852   |
| Current smoker                                                            | 0.61 (0.22-1.67)       | 0.336   |
| Duration of symptoms (>6 months)                                          | 0.41 (0.21-0.80)       | **0.008**|
| CIRS (centered)                                                           | 1.05 (0.97-1.14)       | 0.257   |
| Depression                                                                | 2.42 (1.09-5.37)       | **0.030**|
| Anxiety                                                                   | 1.40 (0.64-3.06)       | 0.405   |
| Degenerative spondylolisthesis (Meyerding Grade ≥I)                       | 0.79 (0.41-1.52)       | 0.486   |
| Number of stenotic levels (>1 level)                                      | 0.93 (0.34-2.49)       | 0.878   |
| 2 Decompressed levels                                                     | 1.47 (0.65-3.29)       | 0.354   |
| 3 Decompressed levels                                                     | 2.22 (0.91-5.44)       | 0.081   |

Overall tests: likelihood ratio test p=0.09
Abbreviations: BMI, body mass index; CI, confidence interval; CIRS, Cumulative Illness Rating Scale
In the sensitivity analysis also the following primarily excluded patients were included (see Figure 1): “no longer interested” (n = 39), “died” (n = 16), “excluded by study nurse” (n = 11), “referred to assisted living residences” (n = 2).
<sup>a</sup> Living alone, or single/divorced/widowed and living in a nursing/residential home
The date of the initial surgery was considered as the index date. Revision (event) is defined as a renewed operation on at least one level that was operated before (index level(s)) or on an adjacent segment after three months of the index operation. Patients were stratified into number of decompressed levels, e.g., patients in the decompression alone group that underwent surgery only on 1 level were compared to patients in the fusion group that underwent surgery only on 1 level.