

# Adjacent segment degeneration and disease following cervical arthroplasty: a systematic review and meta-analysis

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Submitted Dec 24, 2015. Accepted for publication Jan 07, 2016.

doi: 10.21037/jss.2016.01.01

View this article at: <http://dx.doi.org/10.21037/jss.2016.01.01>

## Background

Anterior cervical discectomy and fusion (ACDF) has been the gold standard for the relief of symptoms associated with cervical degenerative disc disease. However, consequent to the fusion resulting in cervical immobilization, many complications, including adjacent segment degeneration and disease, have been identified (1-3). Unlike ACDF, cervical arthroplasty preserves motion at both the index and adjacent disc levels and as such, potentially minimizes adjacent segment degeneration and disease.

## Aims

A recent published a systematic review and meta-analysis investigated the incidence of adjacent segment degeneration and disease and potentially serious complications following cervical arthroplasty (4). This evidence update article will summarize the outcomes of this study and potential implications on clinical practice.

## Search and inclusion criteria

A systematic MEDLINE, SCOPUS and Web of Science search for literature published up to May 21, 2015 reporting on adjacent segment degeneration and disease following cervical arthroplasty was conducted. Only prospective cohort studies and randomized controlled trials (RCTs) were included. No restrictions on publication status were imposed. Studies involving only arthrodesis,

anterior cervical corpectomy and fusion, and hybrid arthroplasty and arthrodesis techniques were excluded. Biomechanical, in vitro, animal and non-English studies were also excluded.

## Data extraction

Data extraction from 32 included articles was conducted independently by two reviewers and compared to confirm accuracy. The included articles were assessed for their level of evidence and risk of bias.

## Statistical methods

The included studies were analyzed using a random-effects model with inverse variance weighting and calculations for the meta-analysis and construction of forest plots were completed using an established spreadsheet constructed by Neyeloff *et al.* (5). The principal summary measures were the effect summary values and 95% confidence intervals (CIs) and the results among studies were compared with 95% CIs and forest plots.

A Q statistic and I<sup>2</sup> value were calculated within each group's meta-analysis to assess for heterogeneity between the individual included studies.

## Results

A total of 1,891 citations were identified from the literature searches and 32 eligible articles comprising 913 patients were included in the final analysis. Of these 32

studies, 22 were RCTs and 10 were prospective cohort studies. A variety of artificial disc types were used with the Bryan cervical disc, utilized in 12 studies, being the most common.

Overall, the incidence of adjacent segment degeneration and disease was 8.3% (95% CI, 3.8–12.7%) and 0.9% (95% CI, 0.1–1.7%), respectively. The incidence of adjacent segment degeneration and disease in those studies following patients for 12–24 months was 5.1% (95% CI, 2.1–8.1%) and 0.2% (95% CI, 0.1–0.2%), respectively. In comparison, the incidence of adjacent segment degeneration and disease in those studies following patients for greater than 24 months was 16.6% (5.8–27.4%) and 2.6% (95% CI, 1.0–4.2%), respectively.

The incidence of adjacent segment degeneration following 1- and 2-level arthroplasty was 7.4% (95% CI, 3.3–11.4%) and 15.6% (95% CI, –9.2–40%) however, the difference between the groups did not reach significance. Despite determining the incidence of adjacent segment disease following 1-level arthroplasty to be 0.8% (95% CI, 0.1–1.5%), the incidence following 2-level arthroplasty could not be analyzed consequent to inconsistencies when reporting in the literature.

Seventeen studies reported reoperation rates with a total of 0.5% (95% CI, 0.1–0.9%) of patients requiring reoperations due to symptomatic adjacent segment pathology.

### Limitations

By limiting the inclusion criteria to prospective studies only, the majority of abstracts and studies identified in the literature search were excluded as they were mostly retrospective case series. In addition, most studies failed to discuss surgical levels in reporting complications. Only three studies separated adjacent segment pathology incidence by single and multilevel arthroplasties, further limiting the analysis. Moreover, the reported reoperation rates may be affected by bias consequent to surgeons avoiding reoperation following cervical arthroplasty. Finally, the authors were unable to elucidate and analyze the differences in adjacent segment degeneration and disease by artificial disc type.

### Clinical implications

The systematic review and meta-analysis provides a comprehensive estimation of the actual incidence

of adjacent segment degeneration and disease (8.3% and 0.9%, respectively) across a heterogeneous group of patients, surgeons and arthroplasty techniques. Furthermore, a statistically significant decrease in the incidence of adjacent segment disease relative to degeneration was identified. Additionally, unlike the incidence of adjacent segment degeneration, the incidence of adjacent segment disease was significantly higher for studies following patients for more than 24 months. Finally, an increased incidence (8.2%), although not statistically significant, was identified in those undergoing 2-level compared to 1-level arthroplasty.

Overall, the investigation should serve as a framework for surgeons to understand the impact of different cervical arthroplasty techniques, surgical levels and follow-up duration on the incidence of both adjacent segment degeneration and disease during the postoperative period.

### Further reading

- ❖ Shriver MF, Lubelski D, Sharma AM, et al. Adjacent segment degeneration and disease following cervical arthroplasty: a systematic review and meta-analysis. *Spine J* 2016;16:168-81.

### Acknowledgements

None.

### Footnote

*Conflicts of Interest:* The authors have no conflicts of interest to declare.

### References

1. Shriver MF, Lewis DJ, Kshetry VR, et al. Pseudoarthrosis rates in anterior cervical discectomy and fusion: a meta-analysis. *Spine J* 2015;15:2016-27.
2. Garrido BJ, Taha TA, Sasso RC. Clinical outcomes of Bryan cervical disc arthroplasty a prospective, randomized, controlled, single site trial with 48-month follow-up. *J Spinal Disord Tech* 2010;23:367-71.
3. Sasso RC, Smucker JD, Hacker RJ, et al. Artificial disc versus fusion: a prospective, randomized study with 2-year follow-up on 99 patients. *Spine (Phila Pa 1976)* 2007;32:2933-40; discussion 2941-2.
4. Bae HW, Kim KD, Nunley PD, et al. Comparison

of Clinical Outcomes of 1- and 2-Level Total Disc Replacement: Four-Year Results From a Prospective, Randomized, Controlled, Multicenter IDE Clinical Trial. *Spine (Phila Pa 1976)* 2015;40:759-66.

5. Neyeloff JL, Fuchs SC, Moreira LB. Meta-analyses and Forest plots using a microsoft excel spreadsheet: step-by-step guide focusing on descriptive data analysis. *BMC Res Notes* 2012;5:52.

**Cite this article as:** Scherman DB, Mobbs RJ, Phan K. Adjacent segment degeneration and disease following cervical arthroplasty: a systematic review and meta-analysis. *J Spine Surg* 2016;2(1):82-84. doi: 10.21037/jss.2016.01.01