Cervical adjacent segment disease

Iit is important to differentiate between radiographical adjacent segment disease (ASD), which is radiographical evidence of degeneration at the levels adjacent to a previous fusion, and clinical ASD, which is the development of clinically relevant symptoms (i.e., radiculopathy and/ or myelopathy) that correlate with radiographical evidence of degeneration that is adjacent to a previous fusion [1].

Epidemiology

Adjacent segment cervical disease occurs in approximately 3% of patients per year, with an expected incidence of 25% within the first 10 years following fusion. Nonfusion procedures such as anterior discectomy and posterior foraminotomy do not decrease the rate of adjacent segment disease compared with Anterior cervical discectomy and fusion (ACDF).

The prevalence during the current follow up periods of 4.5 years and 21 years are 25%-89% [2] [3] [4] and 7%-15%, respectively [5] [6] [7] [8].

Future prospective studies should continue to focus on excellent patient follow-up and accurate assessment of patient symptoms that are attributable to an adjacent level as this has been an under-reported finding in prospective studies [9].

Etiology

Several factors have been associated with the development, such as the number and location of fusion segments, age, and pre-existing degenerative changes at adjacent segments [10] [11] [12].

Lawrence et al. [13] performed a systematic review to determine the risk factors for the development of ASD after cervical fusion surgery. They concluded that the factors contributing to the development include age of less than 60 years, fusing adjacent to the C5-C6 and/or C6-C7 levels, a pre-existing cervical disc herniation, and/or dural compression secondary to spinal stenosis.

Enthusiasm has developed for artificial disk replacement as a motion-sparing alternative to fusion. To date, however, multiple clinical trials and subsequent follow-up studies have failed to demonstrate significant reduction of adjacent segment disease when artificial disk replacement is performed instead of fusion [14].

Total disc arthroplasty

Concerns with adjacent segment disease and the desire to preserve physiological motion have led to technological and clinical efforts for cervical arthroplasty.

The suggested move to cervical disc replacement has led to this latter procedure being one of the most scrutinised surgical treatments in the twenty-first century.

Short- and medium-term prospective randomised clinical trials and systematic reviews show cervical disc replacement to be at least as good as ACDF as regards the clinical outcomes in the management of degenerative cervical spondylosis. This is logical since the neural decompression procedure is essentially the same. However, the rationale for arthroplasty over arthrodesis has been built on two main proposed roles: the preservation of segmental motion and the prevention of adjacent segment disease. Whilst results thus far show that this first role seems to be achieved, its clinical significance is as yet unproven; the second is so far not proven. In addition, the long-term fate of the implants is also unknown. Long-term safety and efficacy, therefore, still await further clinical studies [15].

From a meta-analysis of prospective studies, there is no difference in the rate of ASD for Anterior cervical discectomy and fusion (ACDF) versus total disc arthroplasty (TDA).

There is also an overall lower rate of follow-up for patients with ACDF than for those with TDA. Future prospective studies should continue to focus on excellent patient follow-up and accurate assessment of patient symptoms that are attributable to an adjacent level as this has been an under-reported finding in prospective studies [16] [17].

Case series

Retrospectively, a total of 84 patients who underwent ACDF or ACDF+CP were identified. At final follow-up an MRI was performed and evaluated in this study.

MATERIALS AND METHODS: An MRI of 84 patients who underwent ACDF (46 patients) and ACDF+PS (38 patients) was performed. The mean follow-up was 24 years (17-45 years). None of the patients had a repeat procedure in the cervical spine. The grade of degeneration of the segments adjacent and adjoining to the fusion was assessed via a five step grading system (segmental degeneration index, or SDI) that includes disc signal intensity, anterior and posterior disc protrusion, narrowing of the disc space, and foraminal stenosis. Furthermore, the disc height (DH) and sagittal segmental angle (SSA) of fused segments were measured.

RESULTS: A significantly ($p < .001$) greater SDI was identified at the caudal adjacent segment following ACDF compared to ACDF+CP. No other significant differences were identified in patients following ACDF and ACDF+CP. Between 50% and 96% of all segments showed severe degenerative changes according to SDI. There was no significant difference in DH between the patients following ACDF and ACDF+CP. The SSA in patients who underwent ACDF+CP was significantly greater than in the ACDF patients ($p = .002$).

CONCLUSIONS: In this cohort of patients, cervical plating had no significant impact on segmental degeneration and decrease of disc height in the adjacent and adjoining segments. ACDF+CP seems to preserve the lordotic alignment more with respect to the SSA than ACDF [18].

1)
Bohlman HH, Emery SE, Goodfellow DB, Jones PK. Robinson anterior cervical discectomy and arthrodesis for cervical radiculopathy. Long-term follow-up of one hundred and twenty-two patients. J Bone Joint Surg Am. 1993;75:1298–1307.
2)
Chow DH, Luk KD, Evans JH, Leong JC. Effects of short anterior lumbar interbody fusion on biomechanics of neighboring unfused segments. Spine (Phila Pa 1976) 1996;21:549–555.
3) , 10)
Dohler JR, Kahn MR, Hughes SP. Instability of the cervical spine after anterior interbody fusion. A study

on its incidence and clinical significance in 21 patients. Arch Orthop Trauma Surg. 1985;104:247–250.
4)

Elsawaf A, Mastronardi L, Roperto R, Bozzao A, Caroli M, Ferrante L. Effect of cervical dynamics on adjacent segment degeneration after anterior cervical fusion with cages. Neurosurg Rev. 2009;32:215–224.
5)

Agarwal V, Serafini S, Haglund MM. Incidence of adjacent segment disease in anterior cervical decompression and fusion with autograft without plating versus allograft with plating; Presented at the North American Spine Society 27th Annual Meeting; 2012 Oct 24-27; Dallas, USA.
6)

Goffin J, van Loon J, Van Calenbergh F, Plets C. Long-term results after anterior cervical fusion and osteosynthetic stabilization for fractures and/or dislocations of the cervical spine. J Spinal Disord. 1995;8:500–508.
7)

Lunsford LD, Bissonette DJ, Jannetta PJ, Sheptak PE, Zorub DS. Anterior surgery for cervical disc disease. Part 1: Treatment of lateral cervical disc herniation in 253 cases. J Neurosurg. 1980;53:1–11.
8)

Hilibrand AS, Carlson GD, Palumbo MA, Jones PK, Bohlman HH. Radiculopathy and myelopathy at segments adjacent to the site of a previous anterior cervical arthrodesis. J Bone Joint Surg Am. 1999;81:519–528
9) , 16)

Verma K, Gandhi SD, Maltenfort M, Albert TJ, Hilibrand AS, Vaccaro AR, Radcliff KE. Rate of adjacent segment disease in cervical disc arthroplasty versus single-level fusion: meta-analysis of prospective studies. Spine (Phila Pa 1976). 2013 Dec 15;38(26):2253-7. doi: 10.1097/BRS.0000000000000052. PubMed PMID: 24335631.
11)

Katsuura A, Hukuda S, Saruhashi Y, Mori K. Kyphotic malalignment after anterior cervical fusion is one of the factors promoting the degenerative process in adjacent intervertebral levels. Eur Spine J. 2001;10:320–324.
12)

Song KJ, Choi BW, Jeon TS, Lee KB, Chang H. Adjacent segment degenerative disease: is it due to disease progression or a fusion-associated phenomenon? Comparison between segments adjacent to the fused and non-fused segments. Eur Spine J. 2011;20:1940–1945.
13)

Lawrence BD, Hilibrand AS, Brodt ED, Dettori JR, Brodke DS. Predicting the risk of adjacent segment pathology in the cervical spine: a systematic review. Spine (Phila Pa 1976) 2012;37:S52–S64.
14)

Cho SK, Riew KD. Adjacent segment disease following cervical spine surgery. J Am Acad Orthop Surg. 2013 Jan;21(1):3-11. doi: 10.5435/JAAOS-21-01-3. Review. PubMed PMID: 23281466.
15)

Demetriades AK, Ringel F, Meyer B. Cervical disc arthroplasty: a critical review and appraisal of the latest available evidence. Adv Tech Stand Neurosurg. 2014;41:107-29. doi: 10.1007/978-3-319-01830-0_5. PubMed PMID: 24309922.
17)

Yang B, Li H, Zhang T, He X, Xu S. The incidence of adjacent segment degeneration after cervical disc arthroplasty (CDA): a meta analysis of randomized controlled trials. PLoS One. 2012;7(4):e35032. doi: 10.1371/journal.pone.0035032. Epub 2012 Apr 25. Review. PubMed PMID: 22558112; PubMed Central PMCID: PMC3338823.
18)

Burkhardt BW, Simgen A, Dehnen M, Wagenpfeil G, Reith W, Oertel JM. Is there an impact of cervical plating on the development of adjacent segment degeneration following Smith-Robinson procedure ? A magnetic resonance imaging study of 84 patients with a 24 year follow-up. Spine J. 2018 Sep 6. pii: S1529-9430(18)31120-3. doi: 10.1016/j.spinee.2018.09.001. [Epub ahead of print] PubMed PMID:

30195935.