

Clinical Study

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

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Abstract

BACKGROUND CONTEXT: Cervical arthroplasty is an increasingly popular alternative for the treatment of cervical radiculopathy and myelopathy. This technique preserves motion at the index and adjacent disc levels, avoiding the restraints of fusion and potentially minimizing adjacent segment pathology onset during the postoperative period.

PURPOSE: This study aimed to identify all prospective studies reporting adjacent segment pathology rates for cervical arthroplasty.

STUDY DESIGN/SETTING: Systematic review and meta-analysis were carried out.

PATIENT SAMPLE: Studies reporting adjacent segment degeneration (ASDdegeneration) and adjacent segment disease (ASDdisease) rates in patients who underwent cervical arthroplasty comprised the patient sample.

OUTCOME MEASURES: Outcomes of interest included reported ASDdegeneration and ASDdisease events after cervical arthroplasty.

METHODS: We conducted a MEDLINE, SCOPUS, and Web of Science search for studies reporting ASDdegeneration or ASDdisease following cervical arthroplasty. A meta-analysis was performed to calculate effect summary values, 95% confidence intervals (CIs), Q values, and I² values. Forest plots were constructed for each analysis group.

RESULTS: Of the 1,891 retrieved articles, 32 met inclusion criteria. The patient incidence of ASDdegeneration and ASDdisease was 8.3% (95% CI 3.8%–12.7%) and 0.9% (95% CI 0.1%–1.7%), respectively. The rate of ASDdegeneration and ASDdisease at individual levels was 10.5% (95% CI 6.1%–14.9%) and 0.2% (95% CI –0.1% to 0.5%), respectively. Studies following patients for 12–24 months reported a 5.1% (95% CI 2.1%–8.1%) incidence of ASDdegeneration and 0.2% (95% CI 0.1%–0.2%) incidence of ASDdisease. Conversely, studies following patients for greater than 24 months reported a 16.6% (5.8%–27.4%) incidence of ASDdegeneration and 2.6% (95% CI 1.0%–4.2%) of ASDdisease. This identified a statistically significant increase in ASDdisease diagnosis with lengthier follow-up. Additionally, 1- and 2-level procedures resulted in a 7.4% (95% CI 3.3%–11.4%) and

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15.6% (95 CI–9.2% to 40.4%) incidence of ASDegeneration, respectively. Although there was an 8.2% increase in ASDegeneration following 2-level operations (relative to 1-level), it did not reach statistical significance. We were unable to analyze ASDisease incidence following 2-level arthroplasty (too few cases), but 1-level operations resulted in an ASDisease incidence of 0.8% (95% CI 0.1%–1.5%).

CONCLUSIONS: This review represents a comprehensive estimation of the actual incidence of ASDegeneration and ASDisease across a heterogeneous group of surgeons, patients, and arthroplasty techniques. Our investigation should serve as a framework for individual surgeons to understand the impact of various cervical arthroplasty techniques, follow-up duration, and surgical levels on the incidence of ASDegeneration and ASDisease during the postoperative period. © 2015 Elsevier Inc. All rights reserved.

Keywords: Adjacent segment degeneration; Adjacent segment disease; Cervical arthroplasty; Artificial disc replacement; Systematic review; Meta-analysis

Introduction

Cervical arthroplasty is an increasingly popular alternative for treatment of cervical radiculopathy, myelopathy, and deformity caused by cervical degenerative disease, tumors, infection, or trauma [1–3]. Traditionally, anterior cervical discectomy and fusion (ACDF) has been the gold standard for relief of cervical degenerative disc disease symptoms [1,2,4–6]. Although ACDF provides clinical relief of symptoms, it is associated with a wide array of complications such as pseudoarthrosis, adjacent segment degeneration (ASDegeneration), and adjacent segment disease (ASDisease) [7–9]. Fusion results in cervical immobilization at the index level, consequently producing increased range of motion and intradiscal pressure at adjacent levels [5,6,9,10].

Conversely, cervical arthroplasty preserves motion at the index and adjacent disc levels, avoiding the restraints of fusion and potentially minimizing adjacent segment pathology onset during the postoperative period [5,9,11]. Assessment of disc height, osteophyte formation, end plate sclerosis, calcification of the anterior longitudinal ligament, and narrowing of the disc space may indicate degenerative changes at the adjacent level [12–17]. These radiographic degenerative changes can progress eventually to clinically symptomatic neurologic deficits, which may consequently result in reoperation [8,17–19]. Many cervical arthroplasty devices have been developed in an attempt to reduce these kinematic and clinical concerns following ACDF procedures [10,15,18,20,21].

Accurate knowledge of the incidence of ASDegeneration and ASDisease following cervical arthroplasty is essential for both patients and surgeons. An analysis of the overall incidence of adjacent segment pathology would be useful in educating patients and surgeons during the informed consent process and patient follow-up. We conducted a systematic literature review and meta-analysis to estimate the incidence of this potentially serious complication following cervical arthroplasty and to characterize significant differences in the incidence of ASDegeneration and ASDisease across a variety of situations.

Methods

Study search

We conducted MEDLINE, SCOPUS, and Web of Science database searches with the following search algorithm: “cervical” and (“arthroplasty” or “total disc replacement” or “artificial disc replacement”) or (“total disc replacement” or “artificial disc replacement”) and (“adjacent segment” or “adjacent level”) and (“disease” or “degeneration”) or (“complications” or “outcomes” or “adverse events”). The search returned 1,891 citations (Fig. 1). The search period ended on May 21, 2015.

Inclusion and exclusion criteria

Only prospective cohort studies and randomized controlled trials (RCTs) were included in this meta-analysis because of their superior evidence level compared with that of retrospective cohort studies [22]. In particular, we felt that retrospective studies would more often underreport postoperative complications. To create a more homogenous patient cohort, studies only involving the following procedures were excluded: arthrodesis, anterior cervical corpectomy and fusion, and hybrid arthroplasty and arthrodesis techniques. We imposed no restrictions on publication status. Animal, in vitro, biomechanical, and non-English studies were excluded.

Data collection

Two reviewers (MFS, AS) independently conducted data extraction from the 32 included articles. The extracted data sets were compared to confirm accuracy. Level of evidence for each of the included articles was assessed using the Oxford Centre for Evidence Based Medicine (or OCEBM) Level of Evidence 2 classification system [22]. From the eligible articles, we obtained the following information: study type, publication year, sample size, number of operated levels, follow-up duration (months), average age of patient cohort, artificial disc type, definition of ASDegeneration or ASDisease, number of levels expressing ASDisease and ASDegeneration, incidence of ASDegeneration and ASDisease, and reoperation rates. We

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