Cervical disc arthroplasty

- Vertebral artery injury following cervical disc arthroplasty - A systematic review
- Intraoperative Conversion of Primary Cervical Total Disc Replacement to Fusion: Incidence and Reasons
- Influence of hospital size on postoperative outcomes, length of stay, and costs following single-level cervical disc arthroplasty
- Prediction of heterotopic ossification on the cervical spine with offset of the artificial disc - A finite element study
- Current Trends in the Use of Cervical Collar Immobilization After Cervical Spine Surgery: A Global Survey Analysis
- Long-term results of cervical disc arthroplasty: a single-center retrospective study with a minimum 10-year follow-up
- Postoperative Physical Therapy for Cervical Total Disc Replacement: A Case Report
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An alternative to fusion. Uses an artificial disc to preserve motion at the level of the discectomy.

The results of an observational study were those of the published randomized controlled trials (RCTs), suggesting substantial pain reduction both after anterior cervical interbody fusion (AIF) and Cervical total disc replacement, with slightly greater benefit after arthroplasty. The analysis of atypical patients suggested that, in patients outside the spectrum of clinical trials, both surgical interventions appeared to work to a similar extent to that shown for the cohort in the matched study. Also, in the longer-term perspective, both therapies resulted in similar benefits to the patients [1].

Three-dimensional motion analysis could provide useful information in an objective and quantitative way about cervical motion after surgery. In addition, it allowed us to measure not only main motion but also coupled motion in three planes. ADR demonstrated better retained cervical motion mainly in the sagittal plane (flexion and extension) and better preserved coupled sagittal and coronal motion during transverse plane motion than ACDF. ADR had the advantage in that it had the ability to preserve more cervical motions after surgery than ACDF [2].

Trend

Although the use of CDA relative to ACDF rose from 2010 to 2018, its use has subsequently plateaued between 2018 and 2021 and remained a relatively low percentage of the single-level anterior cervical surgeries performed (14.47% in 2021). The causes for such changes in the trend are unclear [3]

Oezel et al. characterized trends in demographics, comorbidities, and postoperative complications among patients undergoing primary and revision cervical disc replacement (pCDR/rCDR) procedures.

In this retrospective database study, the Premier Healthcare database was queried from 2006 to 2019. Annual proportions or medians were calculated for patient and hospital characteristics, comorbidities, and postoperative complications associated with CDR surgery. Trends were assessed using linear regression analyses with year of service as the sole predictor.

A total of 16,178 pCDR and 758 rCDR cases were identified, with a median (IQR) age of 46 (39; 53) and 51 (43; 60) years among patients, respectively. The annual number of both procedures increased between 2006 and 2019, from 135 to 2220 for pCDR ($p < 0.001$), and from 17 to 49 for rCDR procedures ($p < 0.001$), with radiculopathy being the main indication for surgery in both groups. Mechanical failure was identified as a major indication for rCDR procedures with an increase over time ($p = 0.002$). Baseline patient comorbidity burden ($p = 0.045$) and complication rates ($p < 0.001$) showed an increase. For both procedures, an increase in outpatient surgeries and procedures performed in rural hospitals was seen (pCDR: $p = 0.045$; $p = 0.006$; rCDR: $p = 0.028$; $p = 0.034$).

PCDR and rCDR procedures significantly increased from 2006 to 2019. At the same time, comorbidity burden and complication rates increased, while procedures were more often performed in an outpatient and rural setting. The identification of these trends can help guide future practice and lead to further areas of research [4].

Tu et al. provide a bibliometric analysis with a review of the literature to understand the current trends of clinical practice and research on CDA.

The PubMed database was searched using the keywords pertaining to CDA in human studies that were published before August 2022. Analyses of the bibliometrics, including the types of papers, levels of evidence, countries, and the number of disc levels involved were conducted. Moreover, a systematic review of the contents with an emphasis on the current practice of multilevel CDA and complex cervical disc problems was performed.

A total of 957 articles published during the span of 22 years were analyzed. Nearly one-quarter of the articles (232, 24.2%) were categorized as level I evidence and 33.0% were categorized as levels I or II. These studies clearly demonstrated the viability and effectiveness of CDA regarding clinical and radiological outcomes, including neurological improvement, maintenance, and preservation of segmental mobility with relatively low risks for several years postoperation. Also, there have been more papers published during the last decade focusing on multilevel CDA and fewer involving the comparison of ACDF. Overall, there was a clustering of CDA papers published from the US and East Asian countries. Based on substantial clinical data on CDA for 1- and 2-level disc diseases, the practice and research of CDA show a trend toward multilevel and complex disease conditions.

CDA is an established surgical management procedure for 1- and 2-level cervical disc herniation and spondylosis. The success of motion preservation by CDA- with low rates of complications outscored ACDF in patients without deformity. For more than 2-level disc diseases, the surgery shows a trend toward multiple CDA or hybrid ACDF-CDA according to individual evaluation for each level of degeneration [5]

In the USA between 2009 and 2017 the utilization of single-level cervical disc arthroplasty (CDA) rose

from 5.6 cases for every 100 ACDFs performed in 2009 to 28.8 cases per 100 ACDFs in 2017. The most substantial increases occurred from 2013 onward. The region of highest utilization was the Mountain region (Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Utah, and Wyoming), where 14.3 CDAs were performed for every 100 ACDFs (averaged over the 9-year period of study). This is in contrast to the East South Central region (Alabama, Kentucky, Mississippi, and Tennessee), where only 2.1 CDAs were performed for every 100 ACDFs. Patient factors that significantly increased the odds of undergoing a CDR were age younger than 40 years (OR 15.9 [95% CI 10.0-25.5]; $p < 0.001$), no clinical evidence of myelopathy/myeloradiculopathy (OR 1.5 [95% CI 1.4-1.7]; $p < 0.001$), and a Charlson Comorbidity Index score of 0 (OR 2.7 [95% CI 1.7-4.2]; $p < 0.001$). After controlling for these factors, significant differences in utilization rates remained between regions (chi-square test = 830.4; $p < 0.001$) [6].

Models

Cervical Disc Arthroplasty Models.

Indications

Cervical disc arthroplasty indications

Goal

Cervical arthroplasty was developed with the goal of preserving mobility of the cervical segment in patients with cervical degenerative disc disease.

Technique

1. position: supine, some use halter traction with this

2. equipment:

a) microscope (not used by all surgeons)

b) C-arm

3. implants: schedule vendor to provide a desired artificial disc

4. neuromonitoring: (optional) some surgeons used SSEP/MEP

5. consent (in lay terms for the patient—not all-inclusive):

a) procedure: surgery through the front of the neck to remove the degenerated disc and bone spurs, and to place an artificial disc

b) alternatives:nonsurgical management,surgical fusion(from the front or the back of the neck)

c) complications: swallowing difficulties are common but usually resolve, hoarseness of the voice (< 4% chance of it being permanent), injury to: foodpipe (esophagus), windpipe (trachea), arteries to the brain (carotid) with stroke, spinal cord with paralysis, nerve root with paralysis, possible seizures with MEPs (if used). The disc may eventually wear out and further surgery may be needed

Post-op orders:

1. no cervical collar (the goal is to preserve motion at the operated level)

2. NSAIDs around the clock for ≈ 2 weeks (this inhibits bone growth which theoretically helps avoid undesirable fusion at the operated level)

Anterior cervical disc arthroplasty versus anterior cervical discectomy and fusion

see Anterior cervical disc arthroplasty versus anterior cervical discectomy and fusion.

Contraindications

Cervical disc arthroplasty contraindications.

Complications

Heterotopic ossification

Heterotopic ossification occurs in three-fourths of the patients after anterior cervical disc arthroplasty at two years after surgery, but does not necessarily correspond to clinical outcome, nor loss or preservation of ROM. The McAfee-Mehren classification should be combined with ROM evaluation to properly study HO [7].

Revision surgery and explantation

Between November 2008 and July 2016, 16 patients with prior implantation underwent removal of the Galileo-type disc prosthesis (Signus, Medizintechnik, Germany) due to a call back by industry. In 10 patients C-ADR was replaced with an alternative prosthesis, 6 patients received an ACDF. Duration of surgery, time to revision, surgical procedure, complication rate, neurological status, histological findings and outcome were examined in two institutions.

The C-ADR was successfully revised in all patients. Surgery was performed through the same anterior approach as the initial access. Duration of the procedure varied between 43 and 80min. Access-related complications included irritation of the recurrent nerve in one patient and mal-positioning of the C-ADR in another patient. Follow up revealed two patients with permanent mild/moderate neurologic deficits, NDI (neck disability index) ranged between 10 and 42%.

Anterior exposure of the cervical spine for explantation and revision of C-ADR performed through the initial approach has an overall complication rate of 18.75%. Replacements of the Galileo-type disc prosthesis with an alternative prosthesis or conversion to ACDF are both suitable surgical options without significant difference in outcome [8].

Case series

see Anterior cervical disc arthroplasty case series.

Case reports

A 40-year-old man was treated with cervical discectomy and arthroplasty due to a C6-C7 disc herniation with left C7 radiculopathy. After the treatment, his postoperative follow-up appointments were uneventful for 9 months. However, after 9 months, he reported cervical pain and a right C7 radiculopathy after neck extension. Imaging confirmed a posterior intraprosthetic dislocation, the first case reported to date. The patient was received emergency surgery under neuromonitoring, and the prosthesis was replaced by an ACDF and anterior plate. The insert presented a rupture of the anterior horn. The patient presented no preoperative or postoperative neurological deficit, and his follow-up review revealed no issues.

Lessons: Posterior intraprosthetic dislocation is an extremely rare complication. It may occur with Mobi-C cervical arthroplasty in the case of rupture and oxidation of the polyethylene insert. Spine surgeons should be aware of this potential major complication [9].

References

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