Anterior cervical discectomy and fusion (ACDF)

- Endoscopic Posterior Cervical Foraminotomy and Discectomy
- Positioning and clinical application of the inflection point of the uncinate process in anterior cervical discectomy and fusion (ACDF): a retrospective study
- Mid-Term Functional Recovery After ACDF and ACCF in the Treatment of Adjacent Two-Level Cervical Spondylosis: A Comparative Study
- Postoperative complications in patients with sickle cell disease undergoing single-level anterior cervical discectomy and fusion
- Application of V-shaped stealth decompression technique using ultrasonic bone scalpel in anterior surgery for adjacent two-level cervical spondylosis
- Microvascular free tissue transfer repair of pharyngoesophageal perforation following anterior cervical discectomy and fusion
- Intraoperative Conversion of Primary Cervical Total Disc Replacement to Fusion: Incidence and Reasons
- Effects of Neuromuscular Electrical Stimulation on Chronic Dysphagia in a Single Subject after Anterior Cervical Discectomy and Fusion Surgery: A Case Report

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see also Anterior cervical corpectomy and fusion.

Anterior cervical discectomy and fusion have become one of the most common neurosurgical procedures

From 1999 to 2008, the annual number of cervical discectomies with subsequent fusion for degenerative disc diseases in the USA increased by 67% [1)]

Without special modifications, a routine anterior cervical approach is usually able to access levels C3–C7. In patients with short thick necks, access may be even more limited. In some cases, with long thin necks, up to C2–C3 or as low as C7-T1 can be approached anteriorly.

In addition, to enhance fusion, anterior cervical plates have been developed. They provide immediate stability and maintain spinal alignment [2) 3)].

Classification

Anterior cervical discectomy and fusion classification.

Advantages

Advantages over posterior (nonfused) approach:

Safe removal of anterior osteophytes

Fusion of disc space affords immobility (up to 10%incidence of subluxation with extensive posterior approach).

Only viable means of directly dealing with centrally herniated disc.

ACDF procedures improve segmental sagittal alignment, cervical overall shape, and angles, but these changes are inconsistently related to higher quality-of-life scores [4].

Disadvantages

Anterior cervical discectomy and fusion (ACDF) is the most frequently used surgical procedure for treating cervical radiculopathy and myelopathy. However, there is concern about the high adjacent segment degeneration (ASD) rate after ACDF surgery

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Disadvantages over posterior approach: immobility at the fused level may increase stress on adjacent disc spaces. If a fusion is performed, some surgeons prescribe a rigid collar (e.g. Philadelphia collar) for 6–12 weeks. Multiple-level ACDF can devascularize the vertebral body (or bodies) between discectomies.

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see Two-level or more-level anterior cervical discectomy and fusion

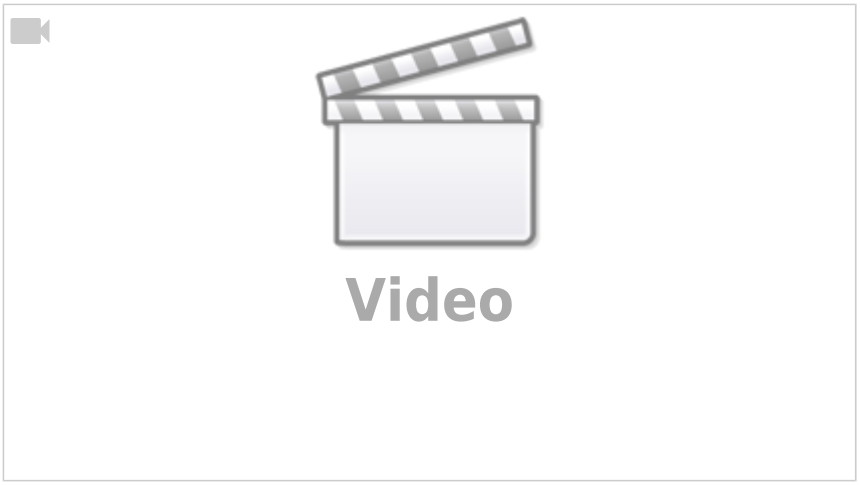
Indications

Anterior cervical discectomy and fusion indications.

Technique

see Anterior cervical discectomy and fusion technique.

Videos



Interbody spacer

see Interbody spacer for anterior cervical discectomy and fusion.

Follow up

Following ACDF, imaging modalities such as standard radiography and computed tomography (CT) are used to assess the fusion, instrumentation failure, and postoperative change such as adjacent segment disease

No standard algorithm for postoperative imaging following ACDF has been defined formally, and the frequency and type of imaging obtained are left to the surgeon's discretion. Due to their relatively low cost and ease of administration, [5].

Due to their relatively low cost and ease of administration, standard radiographs are often ordered for all patients following ACDF to assess fusion status.

However, the use of such “routine” postoperative radiographs has been found to be unwarranted in asymptomatic patients [6] [7] [8].

The ACDF procedure itself can induce regional slope change (C5-s and C7-s) directly at the surgical level and can also influence upper cervical slope change (C1-s and C2s) indirectly. Then the change in the upper cervical spine can induce a change in the sagittal vertical axis (St-SVA) and spino-cranial angle (SCA) [9].

Flexion-extension radiographs

Flexion-extension radiographs are obtained 6 weeks after the operation in patients with a fusion construct. If evidence of fusion is present and there are no signs of pseudarthrosis, patients are started on exercise therapy at that time. Patients who do not undergo a fusion procedure can start exercise 2 to 3 weeks after surgery.

CT

CT is a more sensitive alternative to plain radiography when assessing fusion because of its ability to detail bridging trabecular bone [10].

CT scans following ACDF are not routinely ordered. A CT results in alteration of the treatment in 60% of patients with an abnormal MRI and/or radiograph and persistent symptoms. In contrast, if the patient only has persistent symptoms, only 39% of them will go onto further intervention, suggesting that CT has a limited utility in this population. The probability of detecting abnormal findings on CT subsequent to ACDF is significantly greater when the patient presents with persistent symptoms or abnormal preliminary imaging. Alterations in the treatment course based on abnormal postoperative CT are dependent on postoperative symptoms. Those patients who undergo CT without indication (i.e., without preimaging symptoms or abnormal imaging) are significantly more likely to have negative findings on CT, and even with abnormal CT findings, they are less likely to have an alteration in the treatment course. As such, postoperative CTs following ACDF should be limited to patients who have persistent debilitating symptoms or those with abnormal imaging. This practice will avoid unnecessary cost and patient exposure to ionizing radiation [11].

For patients who undergo a fusion procedure, anterior and lateral radiographs are obtained in the recovery room to verify the position of the graft, the plate, and the screws. Patients without an internal fixation device wear a rigid collar for 4 to 6 weeks. In patients who receive internal fixation and in those who undergo no fusion, external orthosis is not applied routinely, except to control pain. Patients are discharged the day after surgery. A problem with swallowing is the usual reason why patients are kept longer in the hospital. Within 7 to 10 days of discharge, patients are seen in the office for a “wound check.”

Complications

see Anterior cervical discectomy and fusion complications.

Outcome

see Anterior cervical discectomy outcome.

Multicenter observational registry analysis

A multicenter observational registry analysis of 1-year radiographic and clinical outcomes following anterior cervical discectomy and fusion (ACDF) using hydroxyapatite-infused cervical PEEK cage.

Radiographic and clinical outcome data were collected preoperatively and at 6 weeks, 3 months, 6 months, and 12 months postoperatively. To assess fusion, dynamic flexion-extension radiographs were independently evaluated with a validated method. Clinical outcomes were assessed using the following disease-specific measures: Neck Disability Index (NDI) and visual analog scale (VAS) for

neck, left arm, and right arm pain. Patient satisfaction was also evaluated.

A total of 789 ACDF patients (men: 51.5 %/women: 48.5%; mean body mass index: 29.9 kg/m2) were included at the time of analysis, and 1565 segments have been operated. Successful fusion was confirmed in 91.3% of all operated levels after 6 months and 92.2% after 12 months. Mean NDI scores improved significantly ($P < 0.01$) preoperatively (46.3, n = 771) to postoperatively (12 months: 25.2, n = 281). Consistently, mean VAS neck (preoperative: 64.2, n = 770; 12 months: 28.6, n = 278), VAS right arm (preoperative: 42.6, n = 766; 12 months: 20.4, n = 277), and VAS left arm (preoperative: 41.1, n = 768; 12 months: 20.8, n = 277) decreased significantly ($P < 0.01$). Patients reported high satisfaction rates after surgery with no significant changes in postoperative patient satisfaction between 6 weeks and 12 months (95.1%, n = 273).

ACDF with HA-infused PEEK cages demonstrates promising radiographic and clinical outcomes, supporting the potential benefits of incorporating HA into PEEK cages to enhance fusion rates and improve patient outcomes.

Clinical relevance: This study demonstrates a >90% fusion rate by level with reliable improvements in patient-reported outcomes, along with a high rate of patient satisfaction, in a large patient cohort undergoing ACDF with HA-infused PEEK cages [12].

Longitudinal Nationwide Register Studies

This study utilized data from the Finnish national spine register (FinSpine), covering all centers from Finland which perform ACDF surgery. Patients undergoing primary ACDF surgery for DCSD between June 2016 and February 2024 without prior cervical spine surgery were included (n=5,517). Patients were grouped based on the patient symptom status (“Improved” vs. “Indifferent or worse”) at 12 months post-surgery. Predictive factors were identified using classification tree analysis followed by binary logistic regression.

At 12 months, 76.8% (n=1799) of patients reported symptom improvement, while 23.2% (n=542) reported that symptoms were indifferent or worse. Loss to follow-up for the outcome variable was 57.6% at 12-months. The Following factors were associated with better outcomes: shorter preoperative pain duration (≤1 year, OR: 1.95, $P<0.001$), lower preoperative Neck Disability Index (NDI) scores (≤42, OR: 1.37, $P=0.012$), and non-smoking (OR: 1.37, $P=0.030$). The initial diagnosis also influenced outcomes: patients treated for herniated discs and nerve root stenosis were more likely to report improvement compared to those with central canal stenosis or - myelopathy ($P<0.001$). Gender, age, BMI, working status, regular use of pain medication, perioperative complications, muscle weakness, levels fused and use of plate versus stand-alone cage were not independently predictive of outcomes.

Shorter preoperative pain duration, lower NDI scores, and non-smoking status were significant predictors of good outcomes at 12 months after ACDF surgery for DCSD. These findings can help to guide preoperative patient counselling and enhance evidence-based decision making for treating DCSD [13]

Case series

see Anterior cervical discectomy and fusion case series.

Case reports

Maki et al. aimed to identify potential relationships between pathological and radiological assessments of bony fusion after anterior cervical discectomy and fusion (ACDF). ACDF can resolve neurological symptoms related to cervical spondylosis, such as myelopathy and radiculopathy. Intervertebral bony fusion is a key outcome for successful ACDF, often assessed on radiography and computed tomography (CT) images. However, the pathological findings of tissues demonstrating bony fusion after ACDF have not been well studied. This report presents the cases of two female patients, aged 62 and 40 years, who underwent additional ACDFs for recurrent cervical radiculopathy. Findings from CT imaging identified intervertebral calcification in the titanium spacers placed in the first ACDF. In both cases, recurrent compression of nerve roots was observed radiologically. Cervical nerve root block identified habitual symptoms related to recurrent radiculopathy. To resolve the clinical symptoms, additional ACDFs were performed in two cases. In the second ACDF, the titanium cases from the prior ACDF were removed. Histopathological examination of the tissues from the removed cages revealed growth of cartilage tissue. This is the first report concerning the histopathological evaluation of the tissue in titanium spacers placed in ACDF. Completion of intervertebral calcification in titanium spacers placed in ACDF may not signify completion of intervertebral bony fusion after ACDF [14].

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