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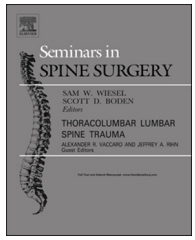

Cervical disc arthroplasty: A selective alternative to fusion

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ARTICLE INFO

ABSTRACT

Anterior cervical decompression and fusion is a dependable and successful treatment option for single-level cervical radiculopathy. However, due to the deleterious effects a fusion has on the kinematics of the adjacent level, artificial cervical disc arthroplasty has become a favorable alternative. Even though the short-term clinical data does not strongly support that a total disc arthroplasty decreases the risk of adjacent segment disease, it does have equal and in some aspects greater clinical outcomes than a fusion. Understanding the biomechanics, indications, outcomes, complications, and implant design will help one better decide which procedure is optimal for a given patient.

1. Introduction

Anterior cervical decompression and fusion (ACDF) is a reliable and effective treatment for cervical radiculopathy and myelopathy.[1] Especially in single-level disease, this well-tolerated procedure consistently relieves neurologic symptoms with minimal complications.[2,3] Despite these results, reoperations can be required for graft subsidence, expulsion, or pseudarthrosis.[4–6] A reoperation can also occur for recurrent radicular symptoms at an adjacent degenerative level. The annual incidence for symptomatic adjacent segment disease after an ACDF is approximately 3%, meaning that up to 25% of patients will at some point undergo a subsequent surgery.[7]

There still exists a debate on the cause of adjacent segment disease being either the natural history of disc degeneration or from post-surgical kinematic changes at the adjacent level. Biomechanical studies have shown that the loss of motion at the fused level leads to compensation by the adjacent level by increasing its motion and its intradiscal pressures which can lead to degeneration. This data supports the theory that adjacent segment disease can be a result of a previous fusion, and this has been the driving force for the development of motion-sparing technology.[8–10]

A cervical disc arthroplasty is an alternative method to treat radiculopathy and myelopathy. This motion-sparing procedure avoids the complications associated with graft healing and also has the advantage of preserving motion at the treated level along with the advantage of reducing increased stress at the adjacent level. In spite of these advantages, cervical disc arthroplasty also has its limitations such as biocompatibility issues, wear, toxicity, heterotopic ossification development, and implant migration.[11–14]

Numerous studies have compared anterior cervical discectomy and fusion to cervical disc arthroplasty.[15–18] These studies support the pros and cons of each procedure in regards to symptomatic relief, complication rate, and the need for a reoperation. The main goal of either procedure is to decompress the nerve, relieving the radicular or myelopathic symptoms. After this is achieved, it is the surgeon's discretion on whether to proceed with a cervical fusion or arthroplasty. The purpose of this article is to provide the information to better guide that decision.

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Table 1 – FDA's contraindications to a cervical disc arthroplasty.

Contraindications				
Cervical instability	Facet arthrosis	Bridging osteophytes	Diabetes	HIV
Osteoporosis	OPLL	Disc height loss >50%	Pregnancy	Hepatitis B/C
Prior surgery at the treated level	Autoimmune disease	Absent motion <2°	Active infection	Ankylosing spondylitis
Morbid obesity	Rheumatoid arthritis	Allergy to metal	Active malignancy	Primarily axial neck pain

2. Indications/contraindications

The primary indications for either an ACDF or cervical disc arthroplasty are (1) constant or recurrent arm pain which has not improved with nonoperative management, (2) any progressive neurologic deficit, (3) a static neurologic deficit that is also associated with severe radicular symptoms, and (4) spinal cord dysfunction (myelopathy) which leads to gait abnormalities, motor weakness, difficulty with fine motor skills, and/or long tract signs. Compression of the spinal cord or nerve root(s) should be confirmed with advanced imaging and the area of compression should be consistent with the dermatome distribution of the patient's symptoms. While an ACDF can be performed for multi-level disease, the cervical disc arthroplasty was historically FDA approved for single-level disease; more recently the Mobi-C (LDR) has gained FDA approval to replace 2 adjacent cervical discs. Other contraindications set forth by the FDA for a total cervical disc arthroplasty are cervical instability (11° rotational difference from other levels and/or translation >3 mm), posterior facet arthrosis, bridging osteophytes, disc height loss >50%, absence of motion <2°, ossification of the posterior longitudinal ligament (OPLL), ankylosing spondylitis, osteoporosis/osteopenia, primarily axial neck pain, prior surgery at the level treated, pregnancy, active infection, active malignancy, insulin-dependent diabetes mellitus, autoimmune disease, rheumatoid arthritis, HIV, hepatitis B/C, morbid obesity, and known allergy to metal materials[19,20] (Table 1). Due to the extensive amount of contraindications, Auerbach et al.[20] demonstrated that approximately only 43% of patients meet the strict criteria to be a candidate for a total cervical arthroplasty, and on average patients who did not meet these criteria had at least 2 contraindications. A relative contraindication to ACDF, which does not pertain to total cervical disc arthroplasty, is the use of nicotine products, which has a deleterious effect on fusion rates.[21] However, a recent study by Luszczyk et al.[22] demonstrated no significant difference in fusion rates between smokers and non-smokers treated with a single-level ACDF.

3. Preoperative imaging

All patients regardless of treatment, ACDF or cervical disc arthroplasty, should have plain radiographs and a magnetic resonance imaging (MRI). Anteroposterior, lateral, flexion, and extension radiographs are essential to assess the cervical alignment, for dynamic instability, or for congenital stenosis. An MRI is done to evaluate for neurologic compression. If a patient cannot undergo an MRI, then a computed tomography (CT) myelogram should be performed. If there is concern for OPLL, then regardless of the treatment a CT scan should be obtained. Patients who are considered candidates for a cervical disc replacement should also have a CT scan if there is concern for posterior facet arthritis to evaluate if the patient is truly an appropriate candidate (Fig. 1).

4. Outcomes

The main goal of a cervical disc arthroplasty is to perform a decompression to improve radicular arm and neck pain while maintaining motion at the treated level, which will biomechanically decrease the stresses at the adjacent levels (seen with ACDF), which in theory could prevent adjacent segment disease. Multiple prospective randomized as well as retrospective studies compared cervical disc arthroplasty to ACDF treatment for single-level disease. These studies evaluated surgical parameters, patient-reported outcomes, neck range of motion, complications as well as the development of adjacent segment disease.

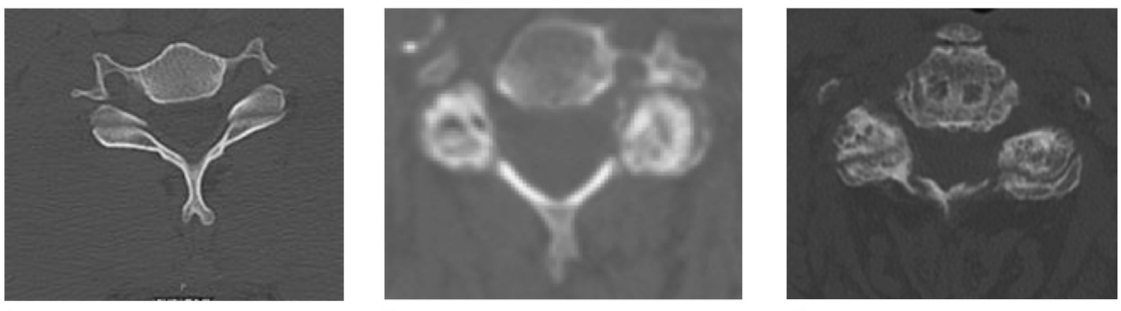

Fig. 1 – CT scan obtained to evaluate for (A) no facet arthrosis, (B) mild facet arthrosis, and (C) severe facet arthrosis. (Adapted with permission from K. Daniel Riew, MD.)