Long Segment Anterior Cervical Discectomy and Fusion, including C2: Technical Report and Case series

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Introduction

Cervical myelopathy is defined as compression of the cervical spinal cord causing neurologic deficits. The neurologic deficits can range from hand weakness and difficulty with gait to quadriplegia. Compression can occur anywhere along the cervical spine from traumatic, degenerative, neoplastic or infectious processes. Degenerative cervical myelopathy is usually more common amongst patients as they age due to gravitational forces over a period of one's lifetime. In degenerative cervical myelopathy the cord compression is usually relieved by removing the bulging discs and decompressing the exiting nerve roots at the affected levels. Once this decompression is performed the spine is usually unstable as a result and needs re-stabilization and fusion. The fusion allows the cervical spine to be realigned to a more natural lordotic alignment. This operation is a commonly performed neurosurgical procedure called anterior cervical disectomy and fusion. ACDFi has proven to be a very effective surgery for the treatment of cervical myelopathy from any cause, whether traumatic, degenerative, infectious, or neoplastic. Through an anterior approach the spine surgeon is able to not only decompress the spinal canal ventrally, but also establish significant lordosis. Compared to a posterior cervical approach, the infection rate is lower anteriorly and the patients tolerate the procedure with less pain postoperatively, as not as much muscle is traversed to accomplish the goal of the operation.

Upper Cervical Challenges

Anatomic and biomechanical differences exist between the axis and the subaxial cervical spine, creating additional surgical challenges when constructs span the C2 segment. Mandibular position, and the submandibular gland necessitate an angled approach in the ventral exposure to C2. Care should be taken to maintain viability of the superior thyroid artery as well as the hypoglossal nerve, which often traverse the upper aspects of the upper aspects of the exposure.

Bone density differences exist between the axis and the subaxial vertebral bodies. Axial loads are transmitted through the occipital condyles, through the C1 pillars, to the C2 facet joints, avoiding to some extent, the anterior inferior portion of the axis body. This lack of axial vertebral forces result in a relative paucity of cancellous bone in this region of the cervical spine. This leads to increase risks of pull-out and back-out in this most cephalad aspect of a construct involving the axis as evidenced by recent case reports.

The anterior inferior portion of C2 is “peeked” in most individuals, as this is an insertion point for the longus colli musculature. This region of the spine lies just posterior to the pharyngeal wall. Evidence exists that airway and swallowing complications are greater with constructs that span the upper cervical spine.

Finally, a cervical venous sinus exists posterior to the C2 vertebral body. In decompressing this region, significant venous bleeding is often encountered, especially near the C3 neuroforamen.

Materials & Methods

A retrospective case review of thirteen patients undergoing five level anterior spinal surgery for cervical myelopathy between 2000-2016. Patients were identified utilizing the department billing database and ICD codes. Of the reviewed, thirteen patients met the inclusion criteria. All patients received preoperative MRI or CT myelography. Patients age, operative indications, levels treated, length of hospital stay, fusion outcome, and operative complications were explored.

Surgical Technique

A discectomy can be carried out in the normal fashion down to the posterior longitudinal ligament. Upon resection of this structure, the epidural veins can be spared laterally. At the C2-3 level, the disc space is significantly more narrow as compared to other spinal levels. To accommodate cage placement the uncovertebral joints can be drilled out on each side. Upon tamping the cage into place, care must be taken to make it flush with the C3 vertebral body, and countersunk with respect to the C2 keel. Next, the C2 keel needs to be removed if an anterior cervical plate is to be applied. This can be drilled down in the midline, so that it is at the same level of the lateral portion of the vertebral body. By doing this, the cervical plate will be relatively countersunk as well. Often times, the anterior cortex is completely removed in the process of keel removal.

The C2 level, in most individuals, is an ideal region to apply a bi-cortical technique for screw insertion, as the cord/canal ratio at this level is quite low. Placing the cervical plate within the removed keel helps to minimize the overall profile of the plate portion of the construct, and allows the plate to load share with the created shelf cephalad to the plate.

Utilizing longer screws into C2 at a cephalad angle likely prevents screw back-out and plate pull-off. With engagement of the posterior cortex, further resistance to back-out is accomplished. Once midline is identified prior to placement of the plate, and after the keel has been removed, the awl technique can be utilized without the presence of the plate. The reason to awl prior to placement of the plate is so that full spine visualization can be accomplished. As a next step, the plate can be placed onto the spine, and the top of the plate can be palpated. If there is a large gap cephalad to the plate, it should be removed so that additional drilling of the anterior cortex of C2 can be accomplished. The plate should be able to lie flat laterally as well, though plates that are wider than 16 mm often will have a lateral gap between the plate and C2.

Conclusions

The current retrospective case review demonstrated the unique technique developed by the senior author (D.J.D) in order to visualize and fully decompress C2-C3 spinal segments. In addition, we explored the efficacy and perioperative risk in long segment ACDFi. While limited literature is available in reviewing the treatment of high cervical pathology, we believe it can be accomplished with good success and is an option more patient can benefit from.

Table I: Patient Demographics

| Number of Patients | 13 |
| Mean Age (years) | 60.2 ± 8.7 |
| (%) Male | 76.9 |
| Mean BMI | 28.9 ± 8.4 |
| (%) Smoking History | 53.8 |
| Mean # Co-Morbidities | 3.8 ± 2.7 |
| # Levels operated | 5.0 |
| Mean Charleston co-morbidity Index | 3.23 |