Anterior Cervical Discectomy and Fusion Case Reports

a report by
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In a previous review,1 we presented the six- to eight-year outcomes for approximately 150 patients who had anterior cervical discectomy and fusion (ACDF) with or without decompression. The outcome surveys, which were self-administered to patients, included a visual analogue scale (0–10.0) for the neck and upper extremity pain, and the Oswestry disability index. High scores indicated greater pain and disability and low scores indicated minimal symptoms. To get a more personal perspective on the results of the ACDF procedure for those with the proper indications, four cases are presented.

Case 1
The patient is a 59-year-old female corporate regulatory affairs consultant who had many years of intermittent neck pain. At presentation, her symptoms had been constant and progressive for approximately seven months. Her pain radiated to the bilateral shoulder regions and upper extremities, and was worse on the right dominant side. There was occasional numbness and tingling about the ulnar digits radiating from the neck, as well as crepitus on range of motion. An examination found a limited range of motion in rotation and extension, which also aggravated her pain. She was neurologically intact except for a mild C7 sensory deficit in the right upper extremity. Plain radiographs and magnetic resonance imaging (MRI) scans revealed spondylosis, particularly at C5–C7, with mild central stenosis and moderately advanced foraminal stenosis particularly at C5–C6 (see Figure 1). She was treated with combined non-steroidal anti-inflammatory medication and physical therapy for three additional months. She then received cervical epidural steroid injections, but they provided only temporary relief. After an additional consultation, the patient underwent ACDF with decompression C5–C7, with iliac bone graft and metallic plate instrumentation. She experienced a dramatic improvement in her neck and upper extremity symptoms and returned to her employment three weeks post-operatively. At her five-year follow-up, her visual analogue pain scale was improved from a pre-operative score of 5.0 to 0.6, and her Oswestry disability score had improved from 28 to 0. A long-term follow-up radiograph (see Figure 2) and MRI scan, as part of an outcome study, found small anterior osteophytes at the level above but no stenosis, and only minimal disc dehydration at the remaining cervical discs.

Case 2
The patient is a 37-year-old male construction supervisor who presented with six months of insidious onset of right-sided neck, shoulder, scapula and arm pain radiating into the hand. His treatment, at first, by his family doctor included oral steroids and non-steroidal anti-inflammatory medication. His past medical history is significant for high cholesterol, but he was otherwise healthy and a non-smoker. The patient was referred to the author, who found him to have a decreased motion in neck extension and a positive Spurling’s test, but he was neurologically intact. His MRI scan revealed a right C6–C7 disc herniation, as well as bilateral foraminal stenosis C5–C6 (see Figure 3). The patient then underwent physical therapy and two right C7 nerve root sheath injections. He had partial short-term relief of pain, but overall had progressive symptoms, including mild sensory and motor deficits in a C7 distribution. Then, a rapid progression of his symptoms ensued, necessitating an emergency room evaluation, initiation of an opioid programme and the inability to work. He was offered surgical management and then underwent an ACDF at C6–C7 using iliac crest bone graft and a bioresorbable plate (Inion Ltd, Finland, see Figure 4). At the time of surgery, a 1.5x0.6x0.6cm extruded disc herniation fragment was retrieved. The patient’s pre-operative neck and arm pain scores were 6.6 and 8.6, respectively, and his pre-operative disability score was 70. Post-operatively, the patient had a full neurological recovery, and outcomes scores improved to 1.2, 0.5 and 14 for neck pain, arm pain and disability, respectively. The patient returned to full-time work and his scores remained stable through the early follow-up period to date.

Case 3
The patient is a 52-year-old female who had a long history of cervical, thoracic and lumbar back pain complaints. She experienced the worst pain in her neck, which had developed over the three years prior to her initial

consultation. The pain radiated to the proximal interscapular region, as well as to the shoulder and proximal right upper extremity. She had undergone multiple sessions of chiropractic, physical therapy, traction and myofascial release resulting in almost a year’s worth of bi-weekly treatments. Much of the therapy was supervised by a physiatrist. Symptoms were aggravated with extension and rotation of the head and neck. Although she would have occasional numbness and tingling from the neck down to the hands, the constant pain was her primary concern. Her past medical history was significant for smoking. The patient was neurologically intact. An MRI scan revealed degeneration at C5–C6 and C6–C7, and inflammatory endplate changes were identified to be worse at C5–C6 (see Figure 5). There was mild central and foraminal stenosis at C5–C7. She underwent a cervical epidural steroid injection, but had only moderate temporary relief. Her pre-operative neck and arm pain scores were 8.0 in severity, and her pre-operative Oswestry disability score was 50. The patient then underwent ACDF from C5–C7 with metallic plate instrumentation for a diagnosis of degenerative disc disease with predominantly axial symptoms (see Figure 6). Post-operatively, she was highly satisfied with the surgical treatment of her neck condition and at her recent four-year follow-up the patient had 0/10 pain for her neck and upper extremities, her disability score was 0 and she was off all pain-relief medication.

Case 4
The patient is a 46-year-old female who had minor episodes of neck pain over the years, but then was in a motor vehicle accident. The patient had pre-existing congenital narrowing of the spinal canal with multilevel stenosis. In addition, she had a C4–C5 disc herniation related to her motor vehicle accident. She underwent multiple sessions of physical therapy, trials of a transcutaneous electrical nerve stimulator (TENS) unit, pharmacological treatment and three cervical spinal steroid injections. Due to the patient’s progressive symptoms, she then underwent ACDF with decompression at C4–C7 with metallic plate instrumentation and iliac crest bone graft. Her pre-operative neck pain, arm pain and disability scores were 4.2, 6.0 and 32, respectively. Post-operatively, she had substantial improvement in her symptoms with neck pain, arm pain and disability scores of 0.5, 0 and 16, respectively. Fifteen months after her surgery, she began experiencing severe right upper extremity pain, numbness, tingling and weakness. An examination identified myelopathic findings of abnormal gait and clonus and right upper extremity motor and sensory deficit in a C8 distribution. An MRI scan found a large right C7–T1 disc herniation (see Figure 7). Conservative treatment at that time included an opioid programme, spinal steroid injections and bracing, which resulted in some improvement in the weakness of her intrinsic muscles of the right hand; however, her gait disturbance persisted, as did her sensory deficit. Due to her continued myelopathic findings and severe pain, the patient underwent extension of her ACDF requiring partial plate removal and repeat iliac crest bone grafting with revision of the plate instrumentation (see Figure 8). Post-operatively, the patient did well and considered herself to be pain-free, although she would have intermittent numbness and tingling in her arms. Since the C7–T1 level may be difficult to visualise on plain radiographs, the patient did have a follow-up high-resolution computed tomography (CT) scan performed one-year post-operatively, confirming a solid union from C4 to T1. She returned to work as a hairdresser, and her self-assessment outcomes scores four years after revision surgery found all scores improved to zero.

Discussion
The first three cases are individuals who represent the three main types of diagnosis commonly treated with ACDF. Case 1 is an example of a patient with stenosis, her long-term five-year follow-up indicating a highly satisfactory result. Instrumentation used at the time of ACDF was a ‘static’ metallic plate. The use of instrumentation leads to higher fusion rates when ACDF is performed at more than a single level.2 Static plates have a higher fusion rate than ‘dynamic’ plates and also maintain lordosis.3 Case 2 is an example of a patient with a disc herniation. The patient had mild to moderate symptoms initially, but then suffered an acute progression with neurological deficit and disabling symptoms. Patients of this kind often have the greatest improvement in outcomes scores. In this one-level case, ACDF may be performed with or without instrumentation (plate) with the same fusion rate; however, internal fixation is thought to decrease brace time.4,5 A recent alternative for
one-level ACDF is the use of a semi-rigid internal fixation. One such product is a bioresorbable plate, which has approximately half the stability given by metallic plates but offers greater load sharing, which is thought to enhance fusion taking place.6 This an example where bioresorbable plates have, possibly, one of their greatest roles for ACDF.

On presentation, the patient was a healthy non-smoker and was willing to comply with a post-operative bracing programme. He also desired to return to work as soon as possible, and a plate was used to try to reduce brace time. Additionally, the patient had foraminal stenosis at the adjacent C5–C6 level, which could become symptomatic in the next decade or two. It was taken into account that, should the patient ever require additional surgery at the adjacent C5–C6 level, a bioresorbable plate would obviate the need for removal. The early results of bioresorbable plates have recently been published in two series.
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large series had fantastic results using a bioresorbable plate (Mystique, Medtronic Sofamor Danek, Memphis, Tennessee) and an exceedingly high fusion rate. Another publication using an identical bioresorbable plate and published within a month of the larger series documented a 50% failure rate. These two articles have widely discrepant results. The author has used this plate in the past, but discontinued for the same reasons encountered by the second series above, and now prefers a more robust bioresorbable plate (Inion Ltd). The author believes the true success rate of bioresorbable plates are somewhere in between the results reported by the two studies, and that patient selection is important for success.

Case 3 is a patient with predominantly axial pain symptoms. There was controversy for performing ACDF for patients with purely discogenic pain. However, this is becoming more accepted and there are now studies documenting improved outcomes for the appropriately selected patient, as demonstrated in our patient. As in Case 1, a plate was used to enhance the fusion rate.

Case 4 demonstrates the potential for problems at the adjacent level above or below an ACDF and some of the challenges in revision surgery, including revising the plate instrumentation. In the author’s study of long-term follow-up patients, the rate of extending an ACDF was 8%. Currently, disc replacement techniques have the theoretical advantage of reducing adjacent level degeneration.

Our results are consistent with what has been previously published, and readers are referred to a recent review article. We have analysed our long-term (six- to eight-year) follow-up of approximately 150 ACDF patients and categorised them based on primary diagnosis of stenosis, disc herniation or discogenic pain with predominantly axial symptoms. All diagnostic groups, with approximately 50 patients in each group, showed a significant improvement in all outcome scales over the follow-up period and is shown graphically for neck pain (see Figure 9). The arm pain scores of patients showed a full two-point (average) additional improvement post-operatively for all groups. Typically, the greatest improvement in outcomes was for those patients with a disc herniation. The patients with purely axial pain due to degenerative disc disease or discogenic pain also show improvement, but not as great as that in the other two diagnostic groups.

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