

CERVICOTHORACIC JUNCTION ARTHROPLASTY AFTER PREVIOUS FUSION SURGERY FOR ADJACENT SEGMENT DEGENERATION: CASE REPORT

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OBJECTIVE AND IMPORTANCE: This is the first reported case of cervical arthroplasty using the Bryan Cervical Disc Prosthesis System (Medtronic Sofamor Danek, Inc., Memphis, TN) in the management of adjacent segment degeneration associated with previous fusion surgery and surgery at the cervicothoracic junction.

CLINICAL PRESENTATION: This case report describes a 25-year-old woman who initially underwent a two-level anterior cervical fusion in 1998, 2 years after being involved in a motor vehicle accident. She was well until 18 months before presentation, when she developed bilateral shoulder pain, mechanical neck pain worse on flexion, and bilateral C8 distribution arm pain and paresthesia. On clinical examination, no focal deficits were found, although the range of motion was reduced. Preoperative cervical spine x-rays and magnetic resonance scanning confirmed accelerated degeneration of the C4–C5 and C7–T1 disc spaces, with evidence of neural compression at those levels.

INTERVENTION: After careful consideration of various treatment options and failure of all conservative measures, the patient underwent an anterior C4–C5 and C7–T1 decompression with removal of the anterior cervical plate and placement of two artificial disc prostheses. After surgery, her course was uncomplicated and she was discharged from hospital well. There was complete resolution of the arm symptoms and reduction of the neck pain, with a reduction in the amount of analgesia she was taking. Seven months after surgery, she remains well with repeat x-rays confirming motion at the operated levels.

CONCLUSION: This case demonstrates that cervical arthroplasty is a reasonable treatment option for patients who have had previous surgery in which interbody fusion has been performed and who have developed degeneration of adjacent levels. Despite the altered biomechanics at the cervicothoracic junction, no adverse features were noted with arthroplasty at this level.

KEY WORDS: Arthroplasty, Bryan disc, Cervicothoracic, Fusion

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The cervicothoracic junction is a unique region of the cervical spine in that it is the junction between the extremely flexible cervical spine and the rigid thoracic spine. The approach to this region is more technically demanding, and management of disorders of the cervicothoracic region is inherently more difficult, because of the many unique neurovascular structures in this region as well as the difficulties in imaging and access to this area (1–5, 7, 8, 14, 18). Cervical arthroplasty has been used to date for the management of disc herniations and spondylotic disease between C3–C4 and C6–C7 (6, 10, 11, 15, 17). Clinical trials up to the

present time have excluded patients who have undergone previous surgery. The impact of previous surgery is unknown in patients undergoing cervical arthroplasty (10, 11).

This case report describes a 25-year-old woman who underwent surgical intervention using an artificial disc prosthesis. It is the first reported cervical arthroplasty at the cervicothoracic junction and the first reported case using the Bryan Cervical Disc Prosthesis System (Medtronic Sofamor Danek, Inc., Memphis, TN) after previous spinal fusion surgery in which adjacent segment degeneration has occurred. The implications of these unique features are discussed.

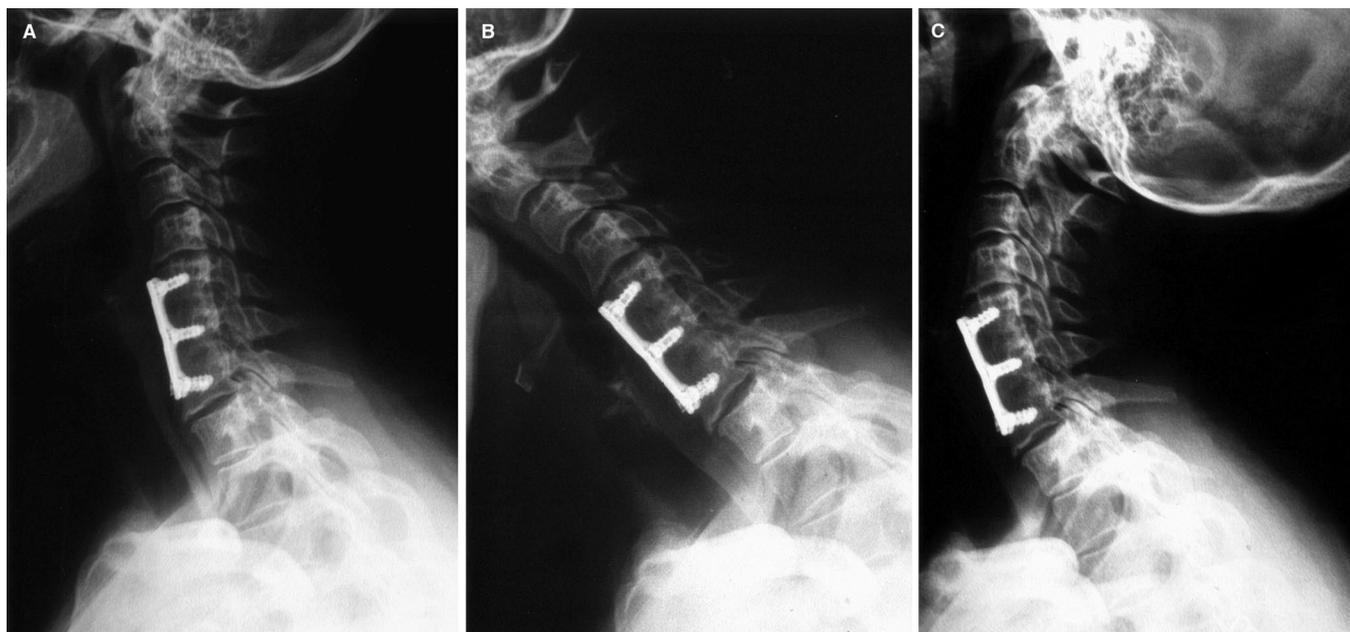


FIGURE 1. Preoperative neutral (A), flexion (B), and extension (C) lateral cervical spine x-rays showing previous solid interbody fusion at the C5–C6 and

C6–C7 levels. The degenerative changes above and below the arthrodesed levels are visible as well as the slight kyphosis above in the cranial subaxial spine.

CASE REPORT

The patient, a 25-year-old woman, was involved in a motor vehicle accident in 1996; at that time, she experienced two cervical disc protrusions. In December 1998, she underwent a two-level C5–C6 and C6–C7 anterior cervical decompression and fusion procedure with left iliac crest grafting and plating. She was well for several years after that but developed new symptoms during the 18 months before presentation at our institution. Her current symptoms encompassed bilateral scapular and trapezius pain, mechanical neck pain, and paresthesia in both arms in the C8 distribution. Physical examination revealed that the patient had a reasonable range of movement of the cervical spine, although extension was limited. There were no focal neurological deficits on examination of the upper or lower limbs.

Preoperative static and dynamic x-rays of the cervical spine and magnetic resonance imaging scans are presented in *Figures 1* and *2*. The plain x-rays revealed a solid fusion from C5 to C7, with mild kyphosis above the level of the fusion. There was suggestion of degeneration of the C4–C5 and C7–T1 disc spaces with osteophytic lipping and loss of disc height. The magnetic resonance imaging scan confirmed that the discs were bulging and degenerative, with some central and foraminal stenosis at both levels above and below the previously fused levels.

The patient was offered surgical intervention in view of the fact that an extensive regimen of conservative therapy had failed. Two-level anterior decompressions were offered, but in view of the significant loss of motion that would occur with a four-level fusion, her current age, and the morbidity associated with her previous iliac crest grafting, the patient requested placement of artificial disc prostheses after decompression. It must be empha-

sized that it was explained to her that the technique was relatively new and somewhat experimental and that the long-term implications were not known.

SURGICAL TECHNIQUE

The precise operative technique has been described elsewhere (10). The previous anterior cervical locking cervical plate was removed. The C7–T1 level was able to be visualized with lateral fluoroscopy. With use of the Bryan Cervical Disc Prosthesis System, an anterior cervical discectomy at C7–T1 was performed, and a 16-mm artificial disc prosthesis was then placed at this level. This was repeated at the C4–C5 level, where a 15-mm prosthesis was placed. There were no complications resulting from the surgical procedure. The total operating time was 2 hours and 50 minutes. No cervical collar was placed.

After surgery, the patient's pain had settled and her numbness had improved. The next day, flexion-extension x-rays of the cervical spine demonstrated maintenance of



FIGURE 2. Preoperative sagittal T2-weighted magnetic resonance imaging scan showing disc bulging at the C4–C5 and C7–T1 levels above and below the fused levels.



FIGURE 3. Postoperative reconstructed sagittal computed tomographic scan showing placement of the artificial disc prosthesis at the C4–C5 and C7–T1 disc spaces.

normal motion at the levels of instrumentation with satisfactory placement of the prostheses. Postoperative computed tomographic scanning (*Fig. 3*) confirmed decompression of the neural structures with satisfactory placement of the prostheses. The patient was discharged 72 hours after surgery and was doing well at the last follow-up examination 10 months after surgery, having halved her preoperative pain medications. Repeat x-rays at that time were satisfactory, with no hardware-related complications and motion at the C4–C5 and C7–T1 levels (*Fig. 4*). The preoperative kyphosis present above the fused levels was unchanged after surgery but was manifest by tilting the shells of the superiorly placed prosthesis. There was no evidence of ectopic calcification or osteophyte formation, and there was integrity of motion.

DISCUSSION

The cervicothoracic junction is unique in many aspects. Bookvar et al. (5) reviewed anterior cervicothoracic junc-

tion surgery and made several pertinent comments. They stated that there are unique biomechanical forces in this region because it is the transition between the most lordotic and mobile cervical spine and the kyphotic and relatively immobile thoracic spine. They concurred that approaches can be challenging because of the unique structures that may be present in this area and also stated that failure of arthrodesis may occur with a higher frequency here because of these factors and that posterior supplemental instrumentation may be required. The approach used in this case achieves single-stage anterior decompression of the cervicothoracic junction; because of the aforementioned shortcomings of arthrodesis in this region, it may, in fact, suggest that maintaining motion in this region is essential to avoid the unique forces in this region leading to construct failure.

Use of the Bryan Cervical Disc Prosthesis System has been reported in the literature for the past 3 years. Goffin et al. (10) originally described the use of the prosthesis for single-level spondylotic disease. The same group more recently reported on their 3-year follow-up experience in this single-level group as well as on their 1-year follow-up experience in those patients undergoing two-level arthroplasty (11). The role of arthroplasty in cervical myelopathy has also been suggested (15), and arthroplasty has been used to reverse a prior cervical fusion (16). The prosthesis was originally developed and recommended for disc or spondylotic disease between C3–C4 and C6–C7. No data are available on its use at the cervicothoracic junction, and, technically, this can be demanding, because the insertion of this prosthesis is performed with fluoroscopic guidance. Navigation systems may allow easier surgery at this level in the future.

Adjacent segment degeneration is one of the most contentious issues in the prognostication of spinal disease as well as in discussion of the potential implications of cervical arthroplasty. Hilibrand et al. (12) reported on the incidence

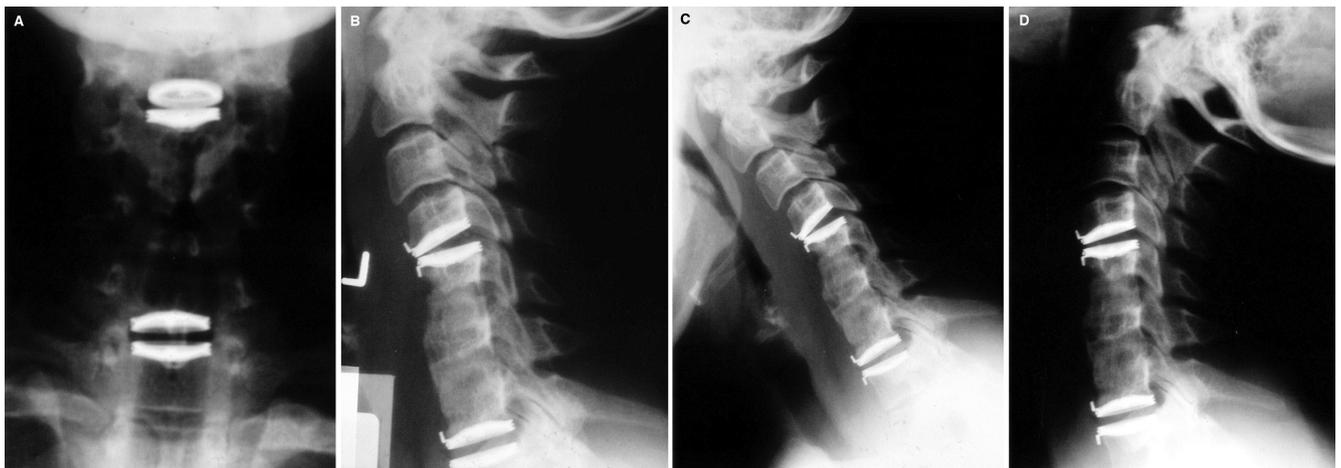


FIGURE 4. Postoperative anteroposterior (A), neutral lateral (B), flexion (C), and extension lateral (D) cervical spine x-rays showing motion at the

C4–C5 and C7–T1 levels. Kyphosis above the previous fusion is reflected in tilting of the C4–C5 titanium shells.

of adjacent segment disease after cervical spine arthrodesis in 374 patients, with a survivorship analysis predicting that 25.6% of these patients would develop new disease at an adjacent level within 10 years after the operation. More than two-thirds of all patients in whom new disease developed had failure of nonoperative management and needed additional operative procedures. Since this publication, other authors have reported abnormal motion adjacent to a fused segment (9, 13).

CONCLUSIONS

This case study reports the unique use of a cervical arthroplasty prosthesis to manage disease at the cervicothoracic junction and at C4–C5, adjacent to a two-level instrumented fusion, in a patient who had undergone previous surgery. Decompression was achieved, and motion was maintained. The clinical and radiological outcomes were satisfactory. The long-term implications of cervical arthroplasty are not known. It may be that the best patients for these procedures are, in fact, those who have undergone previous cervical arthrodesis and are having degeneration at adjacent segments. These patients have fulfilled the criteria for adjacent segment degeneration and have already lost motion segments. Further studies are under way to evaluate this subset of cervical arthroplasty patients, and with long-term follow-up, many unanswered questions may be addressed.

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COMMENTS

This is an interesting application of cervical arthroplasty in the treatment of a degenerative spondylosis at two levels in the cervical spine, above and below a previously performed two-level fusion. I remain on the fence about the usefulness and long-term outcome of cervical disc replacement with a mechanical prosthesis. I salute the forward thinking and investigative efforts of those who lead the development of this technology and its application. I have concerns about the durability of these devices and important patient-related fears about how the devices will fail (gradually or catastrophically?) and how we will treat these patients once device failure occurs. The outcome of this patient at 10 to 12 months after surgery is good, but the follow-up period is much too short to provide any assurance of long-term success. As a practical matter, if the disc space degeneration above (and below) the previous two-level fusion is enhanced or accelerated by a failure of the original procedure to restore cervical lordosis, would not disc replacement (arthroplasty) at a level of cervical sagittal imbalance (kyphosis) be expected to fail as well? We have much to learn about these devices and their ultimate application and usefulness.

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A single case of an arthroplasty procedure is described. Two levels were treated, one of which was C7–T1. This patient's course underscores the problem of adjacent-segment degeneration. The motion at C7–T1 is not normal. The less the segmental mobility before arthroplasty, the less likely it is that motion will be preserved in the long term. The follow-up is rather short, and so we really do not know what the final outcome will be.

The C7–T1 segment is anatomically different from the rest of the subaxial cervical spine. It is the transition between the

relatively flexible cervical spine and the more rigid thoracic spine. It will be interesting to see how arthroplasty devices perform at this level as more patients are treated.

Overall, I commend the treatment course. This relatively young patient has had motion spared at two levels. The preservation of mobility may be the greatest benefit offered by these devices.

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This is a report of a young woman who underwent a two-level fusion at C5–C6 and C6–C7, initially with good results. Adjacent-level disease above and below the level of the

fusion was treated with a Bryan disc prosthesis. Artificial discs were intended only for the treatment of degenerative one- and two-level disc disease. As the author mentions, however, artificial discs might be most valuable for the treatment of adjacent-level disease.

Nonetheless, the follow-up is extremely short (1 yr). Given how young this patient is, the implant might loosen, or further kyphosis, which is already present, might develop or worsen. Still, the author has demonstrated an innovative use of the artificial disc.

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