Chiropractic Care of a Female Veteran After Cervical Total Disk Replacement: A Case Report

Michael Mortenson, DC, [a] Anna Montgomery, MPH, [b] and Glenn Buttermann, MD [c]

ABSTRACT

Objective: The purpose of this case study is to describe chiropractic care of the cervical spine for a patient who previously underwent cervical total disk replacement (CTDR) of the C5-6 and C6-7 disks.

Clinical Features: A 42-year-old female veteran of the U.S. Army presented to a Veterans Affairs chiropractic clinic with chronic cervical pain and radiculopathy. She had previously undergone CTDR surgery of the C5-6 disk 9 years earlier, but the pain had become severe and radicular symptoms had returned in the upper left extremity. Imaging taken before the chiropractic referral demonstrated significant joint space narrowing and disk herniation of the C6-7 disk with protrusion to the left side.

Intervention and Outcome: The patient received spinal manipulative therapy, trigger-point therapy, and manual traction to the cervical spine. However, these treatments were not effective in reducing her cervical pain and radiculopathy. She then opted for CTDR of the C6-7 disk. After surgery, the patient reported that radicular symptoms were mostly relieved and cervical pain had decreased by 50%. After 6 additional spinal manipulative therapy treatments, she reported having no neurologic symptoms and that her pain had decreased more than 70% from presurgery levels.

Conclusion: This case report is the first reported example of chiropractic care after CTDR within an integrated health care environment. The patient's cervical pain and radiculopathy improved with CTDR along with postsurgical chiropractic care. (J Chiropr Med 2022;21;60-65)

Key Indexing Terms: *Chiropractic; Spine; General Surgery; Manipulation, Spinal*

INTRODUCTION

Cervical total disk replacement (CTDR) is gaining popularity among spinal surgeons for its ability to preserve spinal movement while incurring lower rates of adverse side effects than anterior cervical diskectomy and fusion (ACDF).[1-3] The market for CTDR devices is expected to exhibit a growth rate of 21.7% in upcoming years.[4] Cervical total disk replacement is indicated for people with underlying cervical degenerative disk disease, clinical presentation of cervical radiculopathy, and lack of response to conservative treatment.[1,5-9] Contraindications to CTDR include but are not limited to cervical instability, adjacent cervical fusion, posttraumatic vertebral body deficiency or deformity, and neck or arm pain of unknown etiology.[1]

Cervical total disk replacement differs from ACDF in that instead of fusing the consecutive vertebrae together, the disk is replaced with a prosthetic to preserve spinal mobility. While CTDR has lower rates of adjacent-segment degeneration and other complications (eg, arthroplasty, reoperation rates) than ACDF, follow-up studies have found that up to 37% of people who receive CTDR may develop adjacent-segment degeneration and require secondary surgeries.[5,10-12] Before attempting a second surgery, these individuals are strongly recommended to first seek conservative treatments to manage their neck or arm pain.[10,11]

To our knowledge, research on chiropractic treatment specific for people who have had CTDR has not yet been published. Although chiropractic care is recommended for chronic cervical and radicular pain[13] and has been demonstrated to have potential benefit after lumbar TDR,[14] no guidance is available for people who have received CTDR. Therefore, the purpose of this case report is to describe the chiropractic management

[a] Whole Health Department, Fargo VA Healthcare System, Fargo, North Dakota.
[b] Department of Medicine, University of California San Francisco, San Francisco, California.
[c] Surgery, Midwest Spine & Brain Institute, Minneapolis, Minnesota.
Corresponding author: Anna Montgomery, 1851 Steamboat Parkway, Unit 1206, Reno, NV 89521.
(e-mail: *anna.montgomery2@va.gov*).
Paper submitted March 12, 2020; in revised form February 9, 2022; accepted February 9, 2022.
1556-3707

https://doi.org/10.1016/j.jcm.2022.02.008

of chronic cervical pain and radiculopathy for a US veteran after 2 CTDRs.

Case Report

A 42-year-old female veteran of the U.S. Army Reserves presented with lower cervical spinal pain and radicular symptoms in the left upper extremity. During deployment, she had been involved in a military vehicle accident that led to a C5-6 disk herniation and bilateral upper extremity radiculopathy. Her symptoms continued to progress, and 5 years later, she elected to have CTDR of the C5-6 disk using the Prodisc C (Centinel Spine, West Chester, Pennsylvania) disk prosthetic (Fig 1). This surgery was effective for eliminating her symptoms at the time, but the cervical pain and radicular symptoms in the left upper extremity eventually returned. Four years after the CTDR of the C5-6 disk, the patient was referred by her primary care physician to a Veterans Affairs (VA) chiropractic outpatient clinic to address her symptoms.

The presentation was different from the initial injury that led to the C5-6 disk prosthetic. Her symptoms followed the cervical radiculopathy nerve root pattern of C7 and were consistent with dermatomal paresthesia in the left upper extremity, including the forearm to the hand. Examination (manual muscle test) revealed weakness of the left triceps (4 +/5) and loss of reflex in the left triceps (1+). The Spurling test, which was used to test for compression of the cervical neuroforamen, increased C6/C7 nerve root distribution of the left arm.[15,16] Radiographs showed a decrease in the C6-7 disk height compared to adjacent disks, and the MRI showed a C6-7 disk herniation with protrusion to the left side (Fig 2). This herniation within the lateral foraminal interspace of C6-7 was in contact with the left-side C7 nerve root, appearing to cause C7 nerve root entrapment.

Fig 1. *Prodisc C (Centinel Spine, West Chester, Pennsylvania) semiconstrained disk prosthetic, used for both C5-6 and C6-7 cervical total disk replacement surgeries.*

During the exam, there was a loss of cervical range of motion (ROM), with flexion at 30°, extension at 40°, left lateral flexion at 20°, and left rotation at 50° (degrees were documented from the provider's subjective visual observations). The Neck Disability Index (NDI), Visual Analogue Pain Scale (VAS), and Numerical Rating Scale (NRS) were used to document subjective pain. Before treatment, the patient reported her pain to be severe (VAS 88 mm and 75 mm for the neck and arm, respectively, NDI 45/50, NRS 8/10). During this time, the patient was also taking prescribed muscle relaxants and pain medication. No other prior nonoperative treatments were seen in the health record.

The chiropractor recommended a treatment trial of 6 visits to alleviate symptoms, followed by re-examination and continued treatment as needed. During each visit, the chiropractor applied spinal manipulative therapy contacting the cervical paraspinals in the supine position using the high-velocity, low-amplitude diversified technique, trigger-point therapy in the form of manual ischemic pressure on the upper trapezius and cervical spine, and unaided intermittent manual traction for 3 minutes. The patient tolerated the treatments without incident, but there was no change in her pain or radicular symptoms. After the fifth visit, the provider recommended an orthopedic surgical consultation, and the patient agreed to CTDR of the C6-7 disk (Fig 3). This procedure was performed by her original orthopedic spinal surgeon using an anterior approach, which leaves the posterior elements and the muscles untouched during the excision of the entire disk before its replacement with a Prodisc C prosthetic.[17]

Two weeks after surgery, the patient reported her radicular symptoms to be mostly relieved (slight return of C7 dermatomal paresthesia), and there remained mild lower cervical pain (neck VAS 44 mm, NRS 4/10, NDI 14/50). At 6 weeks after CTDR, the patient revisited the VA chiropractic clinic for her residual cervical pain and radicular symptoms in the upper left extremity. After re-examination, the chiropractor consulted the spinal surgeon for guidance on the patient's outpatient care after CTDR. Although the surgeon was in favor of chiropractic care after surgery, he was not aware of any existing recommendations regarding reinitiating spinal manipulation to manage residual symptoms. The patient and chiropractor agreed to a short new trial of chiropractic care consisting of twice-a-week spinal manipulative therapy of the cervical spine.

Chiropractic manipulative therapy was performed with the cervical spine in neutral sagittal alignment, and aimed not to increase in flexion or extension, using the diversified technique. This technique was chosen based on provider

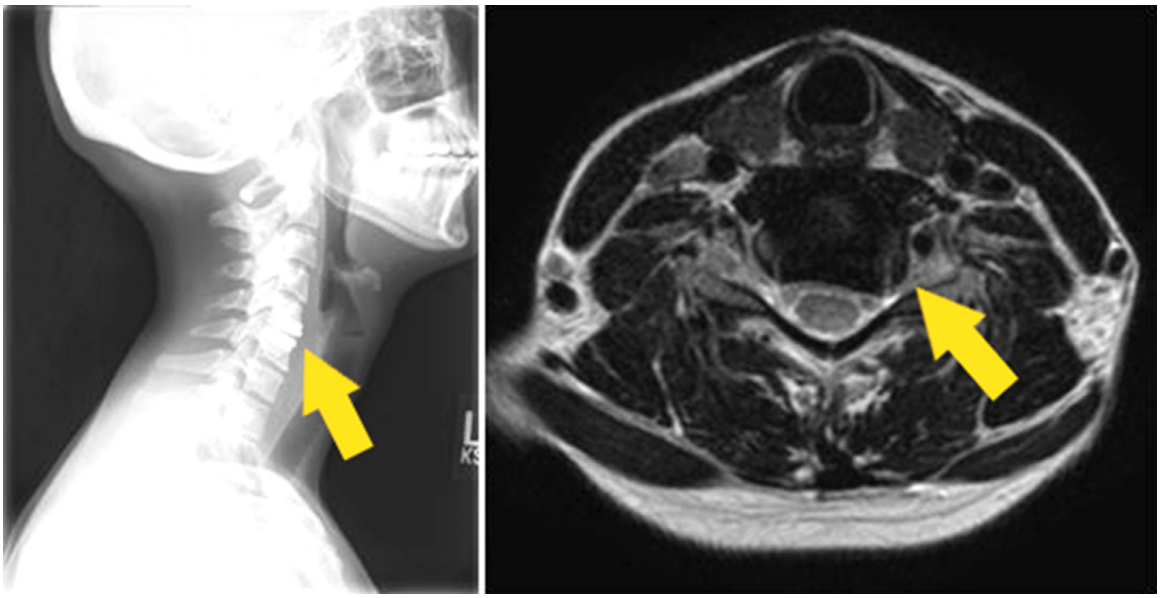

Fig 2. *Prechiropractic care radiograph and MRI. Disk herniation of the C6-7 disk with protrusion to the left side can be seen (right), as well as the previous cervical total disk replacement of the C5-6 disk (left).*

and patient preference. Manipulation was done with the patient in the supine position and the chiropractor's hands supporting the cervical spine in a neutral position that was then laterally bent and rotated to optimize the manipulation. The chiropractor incorporated trigger-point therapy in the form of manual ischemic pressure on the upper trapezius and cervical spine, and unaided intermittent manual traction in conjunction with each spinal manipulation.

The chiropractor took care to reduce the applied level of amplitude during the first manual manipulation of the C6-7

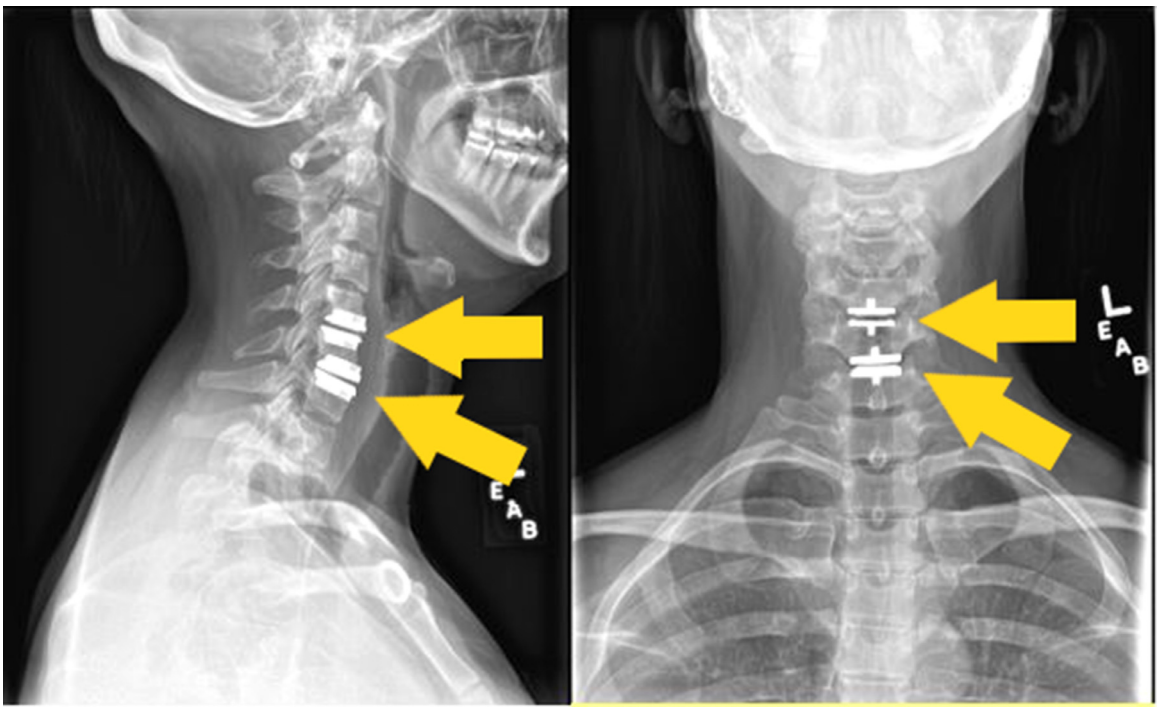

Fig 3. *Radiograph of C6-7 after cervical total disk replacement. The cervical total disk replacements of both the C5-6 and C6-7 disks are visible in these lateral (left) and posteroanterior (right) radiographs.*

segment without reduction in velocity. The amplitude was subjectively increased according to patient tolerance in the following visits. There were no adjunct therapeutic exercises prescribed during the first 6 treatments, as the chiropractor wanted to solely evaluate the effectiveness of the treatments without interference from exercises that could potentially confound the patient's response.

After the sixth visit in the trial of care, the patient was no longer experiencing radicular symptoms and had only intermittent mild pain (VAS 25 mm and 0 mm for the neck and arm, respectively, NDI 11/50, NRS 0-2/10), and ROM was restored to anatomically normal cervical ROM.[17] The patient received spinal manipulation and was then encouraged to use isometric therapeutic exercises to strengthen her postural muscles. She tolerated adjustments without reporting adverse events.

At 1-year follow-up visits, the patient's condition was stable, without any radicular symptoms and with only intermittent mild cervical pain (NRS 0-2/10), manageable through nonoperative treatments. The patient continues to receive chiropractic care once a month for mobility and tertiary prevention, with the addition of medical massage and ongoing therapeutic exercises. The goals of ongoing management of her pain, although mild and intermittent, were to minimize her need for pain medications, maintain therapeutic gains, and maximize her capacity for activities of daily living.[13] Consent for publication was obtained from the patient.

Discussion

This is the first instance, to our knowledge, of a published case of chiropractic manipulation after CTDR. Before this case report, there was no available literature to guide chiropractic care after CTDR. This will hopefully serve as a call for future research to guide clinicians in the management of patients after CTDR. Evidence-based guidelines for chiropractic care after CTDR would be of value for chiropractors and other health care practitioners in guiding optimal patient care. This case report will hopefully stimulate discussion and future efforts to create a guideline for postsurgical chiropractic care in CTDR.

The optimal treatment dosage for chiropractic treatment depends on the severity, chronicity, and demographic characteristics of the patient.[13] Whalen et al published a chiropractic best practice recommending treatment of acute neck pain 3 times per week for 4 weeks, and chronic neck pain 2 times per month for several months; additionally, chronic neck pain with radiculopathy may take several months to treat, with an initial trial of care consisting of treatments 3 times per week for 4 weeks and then tapering in frequency as the patient improves.[13] In attempting to be consistent with guidelines recommended by the VA Chiropractic Field Advisory Committee, the initial trial of care consisted of 6 visits, which was stretched over 3 weeks.[18] After the initial 6-visit trial, care was continued twice a week for several weeks before treatment frequency was tapered as the patient improved.

The treating provider used the minimal force necessary during the initial cervical manipulations, to limit potential adverse reactions. Before treatment, the patient was put in a lateral preload position to assess her tolerance and suitability for spinal manipulation. Although audible cavitation does not necessarily provide evidence for physiological benefit of a manipulation,[19] audible cavitation, the patient's subjective pain assessments, and improved ROM were noted to determine treatment success. By the sixth visit, the patient was adjusted at the normal velocity and amplitude of the high-velocity, low-amplitude diversified technique.

Although there is a paucity of studies on outpatient care after CTDR, some studies have explored care pathways after lumbar TDR. In a study by Braxton et al, a surveyed panel of spinal surgeons agreed that physical therapy could be initiated 2 to 4 weeks after surgery.[20] In another study by Green et al, clinic-based physical therapy initiated 4 weeks after CTDR significantly improved functional disability, pain, and quality-of-life outcomes compared to self-mediated rehabilitation.[21]

The type of artificial disk used—the Prodisc C semiconstrained "fixed" center-of-rotation disk prosthetic (Fig 1)—prevents spondylolisthesis or scoliosis compared to those seen with unconstrained "mobile" core CTDR types.[22] In the present case, the device also had small fins which are fitted into the adjacent bony endplates, allowing for immediate stability during the early period in which endplate bone grows into the device's ingrowth surfaces. An additional feature that differs between CTDRs is the amount of endplate coverage, or "footprint," of the prosthesis. A large footprint prevents device subsidence and minimizes heterotopic ossification and recurrent foraminal stenosis.[23] These features expedite healing and aid in stability, which allowed for the decision to attempt spinal manipulative therapy 6 weeks after surgery.

Limitations

While this case report contributes to the sparse literature on chiropractic care after CTDR, it is important to recognize that generalizations from a case report are limited; each patient case must be considered individually. This case used many subjective measurements that may not be reproducible in future studies. It is important to acknowledge that not all prosthetics are suitable for spinal manipulation 6 weeks after surgery, and some may require a lengthier protected healing time to ensure stability. For example, in a study by Goffin et al, the unconstrained "mobile" Bryan disk implant had problems in maintaining focal cervical lordosis, and postoperative malalignment

was frequently reported.[24] In addition, there could have been confounding variables that resulted in the patient outcomes. More research is needed to guide chiropractic care of patients after CTDR.

Conclusion

This case report is the first reported example of chiropractic care after CTDR. The patient's cervical pain and radiculopathy improved with CTDR along with postsurgical chiropractic care.

Funding Sources and Conflicts of Interest

This material is the result of work supported with resources and the use of facilities at the Fargo VA Health Care System. The contents do not represent the views of the U.S. Department of Veterans Affairs. No conflicts of interest were reported for this study.

Contributorship Information

Concept development (provided idea for the research): M.M., A.M., G.B.
Design (planned the methods to generate the results): M.M., G.B.
Supervision (provided oversight, responsible for organization and implementation, writing of the manuscript): M.M., A.M.
Data collection/processing (responsible for experiments, patient management, organization, or reporting data): M.M., A.M., G.B.
Analysis/interpretation (responsible for statistical analysis, evaluation, and presentation of the results): A.M.
Literature search (performed the literature search): A.M.
Writing (responsible for writing a substantive part of the manuscript): M.M., A.M.
Critical review (revised manuscript for intellectual content, this does not relate to spelling and grammar checking): M.M., A.M., G.B.

Practical Applications

- This case report is the first reported example of chiropractic care after cervical total disk replacement within an integrated health care environment.
- After a course of chiropractic care, the patient reported improvements in cervical pain and radiculopathy that were not fully relieved previously by the double cervical total disk replacement.

References

1. Auerbach JD, Jones KJ, Christian IF, Balderston JR, Rushton SA. The prevalence of indications and contraindications to cervical total disc replacement. *Spine J*. 2008;8(5):711-716.
2. Davis RJ, Nunley PD, Kim KD, Hisey MS, Jackson RJ. Two-level total disc replacement with Mobi-C cervical artificial disc versus anterior discectomy and fusion: a prospective, randomized, controlled multicenter clinical trial with 4-year follow-up results. *J Neurosurg Spine*. 2015;22(1):15-25.
3. Zhong ZM, Zhu SY, Zhuang JS, Wu Q, Chen JT. Reoperation after cervical disc arthroplasty versus anterior cervical discectomy and fusion: a meta-analysis. *Clin Orthop Relat Res*. 2016;474(5):1307-1316.
4. Coherent Market Insights. Cervical total disc replacement device market analysis. Available at: https://www.coherentmarketinsights.com/market-insight/cervical-total-disc-replacement-device-market-1763. Accessed July 23, 2020.
5. Robertson JT, Papadopoulos SM, Traynelis VC. Assessment of adjacent-segment disease in patients treated with cervical fusion or arthroplasty: a prospective 2-year study. *J Neurosurg Spine*. 2005;3(6):417-423.
6. Murrey D, Janssen M, Delamarter R, et al. Results of the prospective, randomized, controlled multicenter Food and Drug Administration investigational device exemption study of the ProDisc-C total disc replacement versus anterior discectomy and fusion for the treatment of 1-level symptomatic cervical disc disease. *Spine J*. 2009;9(4):275-286.
7. Puttlitz CM, Rousseau MA, Xu Z, et al. Intervertebral disc replacement maintains cervical spine kinetics. *Spine (Phila Pa 1976)*. 2004;29(24):2809-2814.
8. Zhou HH, Qu Y, Dong RP, Kang MY, Zhao JW. Does heterotopic ossification affect the outcomes of cervical total disc replacement? a meta-analysis. *Spine (Phila Pa 1976)*. 2015;40(6):332-340.
9. Leven D, Meaike J, Radcliff K, Qureshi S. Cervical disc replacement surgery: indications, technique, and technical pearls. *Curr Rev Musculoskelet Med*. 2017;10(2):160-169.
10. Lavelle WF, Riew DK, Levi AD, Florman JE. Ten-year outcomes of cervical disc replacement with the BRYAN cervical disc: results from a prospective, randomized, controlled clinical trial. *Spine (Phil Pa 1976)*. 2019;44(9):601-608.
11. Hisey MS, Zigler JE, Jackson R, et al. Prospective, randomized comparison of one-level Mobi-C cervical total disc replacement vs. anterior cervical discectomy and fusion: results at 5-year follow-up. *Int J Spine Surg*. 2016;10:10.
12. Kumar C, Dietz N, Sharma M, Wang D, Ugiliweneza B, Boakye M. Long-term comparison of health care utilization and reoperation rates in patients undergoing cervical disc arthroplasty and anterior cervical discectomy and fusion for cervical degenerative disc disease. *World Neurosurg*. 2020;134:e855-e856.
13. Whalen W, Farabaugh R, Hawk C, et al. Best-practice recommendations for chiropractic management of patients with neck pain. *J Manipulative Physiol Ther*. 2019;42(9):635-647.
14. Oshaughnessy J, Drolet M, Roy J-F, Descarreaux M. Chiropractic management of patient's post-disc arthroplasty: eight case reports. *Chiropr Osteopat*. 2010;18(1):7.
15. Tong HC, Haig AJ, Yamakawa K. The Spurling test and cervical radiculopathy. *Spine (Phila Pa 1976)*. 2002;27(2):156-159.
16. Rainville J, Joyce AA, Laxer E, et al. Comparison of symptoms from C6 and C7 radiculopathy. *Spine (Phila Pa 1976)*. 2017;42(20):1545-1551.

17. Demaille-Wlodyka S, Chiquet C, Lavaste JF, Skalli W, Revel M, Poiraudeau S. Cervical range of motion and cephalic kinesthesis: ultrasonographic analysis by age and sex. *Spine (Phila Pa 1976)*. 2007;32(8):E254-E261.
18. VHA Chiropractic Field Advisory Committee. *General Guidance on Chiropractic Treatment Frequency and Duration*. West Haven, CT: Veterans Health Administration Chiropractic Program Office; 2013.
19. Bakker M, Miller J. Does an audible release improve the outcome of a chiropractic adjustment? *J Can Chiropr Assoc*. 2014;48(3):237-239.
20. Braxton E, Wohlfeld BJ, Blumenthal S, et al. Postoperative care pathways following lumbar total disc replacement: results of a modified Delphi approach. *Spine (Phila Pa 1976)*. 2019;44:S1-S12.
21. Green A, Gilbert P, Scott-Young M, Abbott A. Physiotherapeutic rehabilitation following lumbar total disc replacement: a retrospective study. *Physiother Res Int*. 2016;21(3):155-163.
22. Vital JM, Boissiere L. Total disc replacement. *Orthop Traumatol Surg Res*. 2014;100(1):S1-S14.
23. Anderson PA, Rouleau JP. Intervertebral disc arthroplasty. *Spine (Phila Pa 1976)*. 2004;29:2779-2786.
24. Goffin J, Casey A, Kehr P, et al. Preliminary clinical experience with the Bryan cervical disc prosthesis. *Neurosurg*. 2002;51:840-845.