

# SYNERGISTIC TREATMENT METHODS OF STRUCTURAL REHABILITATION (CBP®) AND NEUROSURGERY MAXIMIZING PRE- AND POST-OPERATIVE CERVICAL LORDOSIS AND PATIENT OUTCOME IN CERVICAL TOTAL DISC REPLACEMENT

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## ABSTRACT

**Objective:** We discuss the management of cooperative cervical total disc replacement and Chiropractic BioPhysics® interventions pre- and post-operatively aimed at restoring physiologic cervical lordosis.

**Clinical Features:** A 38-year-old woman had neck pain radiating into her right shoulder and scapula coupled with paresthesia to the first and second digits, bilaterally. Radiographs revealed significant loss of segmental and global lordosis with degenerative stenosis at C5-C6.

**Intervention and Outcome:** Preoperatively, conservative methods of chiropractic therapy were completed with progress toward restoration of cervical lordosis but without resolution of symptoms. The patient underwent anterior cervical discectomy at C5-6 and a total disc replacement. Postoperatively, traditional physical therapy failed and Chiropractic BioPhysics cervical extension traction methods helped improve clinical symptoms and lordosis. Successful results were maintained at a 2.5-year follow-up.

**Conclusion:** This case demonstrates how a combined approach of cervical total disc replacement and

Chiropractic BioPhysics technique may help manage degenerative changes in the neck. This can then help lead to future cooperation between specialties. (*J Contemporary Chiropr* 2022;5:1-6)

**Key Indexing Terms:** Total Disc Replacement; Cervical Lordosis; Cervical Spine; Chiropractic

## INTRODUCTION

The normal cervical lordosis has been shown to have significant clinical importance, as its loss or reversal is associated with altered kinematic patterns (1-5), pain (6-8), neurological sequelae (9-11), as well as degenerative changes (12-15).

Total disc replacement (TDR) is a surgical procedure that rivals the traditional approach of fusion of the cervical vertebrae for candidates with spondylosis. Improvement in health outcomes have been shown to be superior for TDR over fusion approaches (16,17), and TDR is thought to be biomechanically superior for maintenance of physiologic motion patterns, anatomical disc height, and normal lordosis (18).

Contemporary approaches to cervical spine surgery attempt to preserve and/or re-establish the cervical lordosis (19,20). This is because a post-surgical lordosis is essential for better patient outcomes and less reoperation rates, particularly for the phenomenon of adjacent intervertebral disc disease, or 'adjacent disc disease' (ADD) (13-15).

As surgical techniques have evolved for the maintenance of post-surgical cervical lordosis, so too has there been advances in conservative, nonsurgical approaches to treat cervical spine disorders involving hypolordosis/

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kyphosis. Advances in Chiropractic BioPhysics® (CBP®) technique involving cervical extension traction methods have demonstrated consistency in the structural re-establishment of cervical lordosis in symptomatic patients following intervention (21-26).

We discuss the management of a patient who underwent TDR for C5-C6 who also received pre- and post-surgical conservative extension traction procedures to re-establish physiologic cervical lordosis. The outcomes and clinical co-operative results are presented and discussed.

## CASE REPORT

A 38-year-old female homemaker and casual athlete had a 2-month history of neck pain radiating into the right shoulder and scapula, with pain and paresthesia to the first and second digits bilaterally. She had been referred to a chiropractor trained in Chiropractic BioPhysics® (CBP) technique [a posture/spine correcting technique (27,28)] by a pain management specialist after failed treatment with epidural injections. She underwent a cervical spine



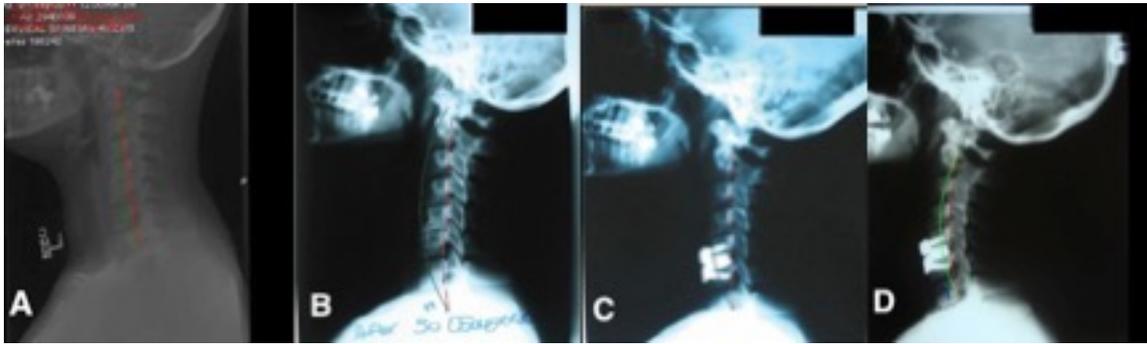
**Figure 1.** Magnetic resonance image. Radiology reported noted generalized disc osteophyte complex at C5-6 with moderate canal stenosis. Mild lateral recess encroachment greater on the right than the left and moderate to severe bilateral neural foraminal narrowing at this level.

MRI prior to that visit (Figure 1), which showed a loss of disc height at C5-6 with foraminal stenosis bilaterally and mild central stenosis.

She had a blood pressure of 130/70 mmHg, a heart rate of 80 bpm, a height of 152.4cm, a weight of 60.8kg, and was left-hand dominant. Dermatomal evaluation elicited a C6 hypoesthesia of her left upper extremity and C7 hypoesthesia of her right upper extremity. She also had decreased cervical range of motion (ROM), particularly in flexion. Orthopedic evaluation revealed positive shoulder depressor bilaterally and positive Soto-Hall's test. She stated she was taking over-the-counter NSAIDs, as well as Singulair® for seasonal allergies.

She reported a 7/10 for both neck and right arm pain on the numerical rating scale (NRS: 0= no pain; 10= worst pain ever). The patient scored 24% on the neck pain disability index questionnaire (NDI). Postural evaluation showed a forward head translation. Radiographic analysis was performed using the PostureRay system (PostureCo, Inc., Trinity, FL) which incorporates the Harrison posterior tangent method to measure lateral spine angles which has high intra- and interclass correlation coefficients and a low standard error of measurement (29). The analysis revealed a global lordosis, absolute rotational angle (ARA) between C2 and C7 of  $-1.9^\circ$  and an intersegmental, relative rotational angle (RRA) at C4-C5 measuring  $+2.3^\circ$ , and the RRA at C5-C6 of  $-1^\circ$ , versus the theoretical ideal RRA of  $-8^\circ$  or the average normal value of  $-6^\circ$  (30) (Figure 2; Table 1).

The initial treatment plan was prescribed for care at a frequency of 3 times per week to include a combination of a manual impulse adjustments, cervical distraction long-axis (Y-axis) decompression traction for 10 minutes per session, cryotherapy, myofascial release, and interferential electrical stimulation of the cervical and thoracic spinal regions. After a short course of 3-point bending cervical lordosis traction, which the patient did not tolerate well, she was transitioned to a cervical extension traction Denneroll™ orthotic (21). The patient completed 50 sessions of the Denneroll orthotic traction over 3 months (Figure 3A). The patient's C2-C7 ARA improved from  $-1.9^\circ$  to  $-11.2^\circ$  of extension, approximately a  $9^\circ$  change. These conservative interventions, however, only yielded mild subjective improvements. MRI analysis coupled with a fair to poor response to conservative therapies warranted referral for surgical consultation. Given the patient's plateauing of clinical response from both epidural spinal injections and conservative rehabilitation, the patient underwent a C5-C6 TDR. A Prestige Artificial Disc (Medtronic™) was implanted at the C5-C6 disc space (Figure 2). The surgery was uneventful, the operating room time was 35 minutes, and estimated blood loss was 10 cc. The hospital stay was 4.5 hours, as this was an outpatient surgical procedure.



**Figure 2.** Lateral cervical radiographs. A. Initial prior to treatment; B. Post-initial CBP traction featuring mild lordosis improvement; C. Post-surgical featuring implanted C5-C6 total disc replacement; D. Post-CBP traction featuring significant lordosis improvement.

After the TDR procedure, the patient returned to the rehab clinic for follow up post-surgical radiographs and physiotherapy exercises. She performed 12 sessions of in office active mirror image® exercises including neck and back extension exercises performed for 3 sets and 15 repetitions and abdominal core stability exercises, over 4 months, while also performing the same therapy at home 3-7 times per week. This exercise program did not increase the cervical lordosis; for this reason, once approved by the surgeon, cervical extension traction was again commenced.

Three months after surgery, she began cervical lordosis 3-point bending traction (21) therapy in a universal traction system (UTS: LV, Nevada) device (Figure 3). The therapy included 19 treatments, at a frequency of 3 times per week of CBP methods of lordosis restoration traction on the UTS, mirror image neck extension exercises (Figure 3), and impulse instrument adjustments to the cervical and thoracic regions.

Radiographic analysis revealed a cervical lordosis (C2-C7 ARA) improvement from  $-5.8^{\circ}$  to  $-30.4^{\circ}$  of extension (Figure 2; Table 1). This is approximately  $25^{\circ}$  of improvement in lordosis. The segmental RRA between C5-C6, the level of surgical disc replacement, improved to  $-6.7^{\circ}$ .

A 9-month follow up demonstrated the RRA of C5-C6 of  $-6.3^{\circ}$  ( $-8^{\circ}$  representing ideal) and an ARA of C2-C7 to be  $-24.7^{\circ}$ . Both neck and arm pain were reported to be a 1/10. The 1.5 year follow up revealed a C5-C6 RRA of  $-7.6^{\circ}$  and a C2-C7 ARA of  $-31.1^{\circ}$ ; the NRS for neck/arm pain was 1/10 and the NDI score was 0%. A 2.5 year follow up showed the preservation of the C5-C6 RRA of  $-7.0^{\circ}$ , and a C2-C7 ARA of  $-17.6^{\circ}$ ; the NDI was 2% (Figure 2; Table 1). The patient gave consent to the publication of these results including any radiographs and images taken during treatment.

## DISCUSSION

This case demonstrates a successful outcome in a patient receiving both conservative CBP cervical extension traction methods before and after a C5-C6 surgical TDR in a symptomatic patient with spondylopathy. It is rare for such cases to be documented; however, since the goals of cervical TDR as well as treatment for hypolordosis/kyphosis are to re-establish the normal lordosis, we propose that such coordinated care should be adopted when appropriate.

There is increasing evidence that cervical TDR for properly selected patients have more favorable outcomes compared to cervical fusion (16,17,31). Delamarter and

**Table 1.** Lateral cervical radiographic measurements.

	Ideal values	Oct, 2011 Initial	Jan, 2012 Post-CBP	May, 2012 Post-TDR	Oct, 2012 Post-CBP	Jul, 2013 9m f/u	Apr, 2014 1.5y f/u	Apr, 2015 2.5y f/u
FHP (mm)	0.0	15.4	-7.3	0.4	4.6	19.0	-4.0	2.0
ARA C2-7	-42.0	-1.9	-11.2	-5.8	-30.4	-24.7	-31.1	-17.6
RRA C2-3	-10.0	+3.5	-4.8	-4.6	-6.1	-6.5	-8.9	-5.7
RRA C3-4	-8.0	-5.6	-1.0	-1.1	-9.3	-7.3	-6.8	-3.3
RRA C4-5	-8.0	+2.3	+3.9	0.0	+0.8	-4.3	-1.8	+3.3
RRA C5-6	-8.0	-1.0	-2.7	-4.1	-6.7	-6.3	-7.6	-7.0
RRA C6-7	-8.0	-1.0	-6.6	+4.0	-9.1	-0.3	-6.0	-3.5



**Figure 3.** A. Denneroll cervical extension traction (picture courtesy of [www.idealspine.com](http://www.idealspine.com)); B. Cervical mirror image extension exercises with resistance; C. Cervical extension traction (forward mid cervical pull; backward head extension with slight distraction).

Zigler (31), for example, found that patients randomized to TDR vs. discectomy and fusion had a 5-fold less reoperation rate. Rates of reoperation for fusion can be greater than 25% over a 10-year period, where ADD has been found to have a constant incidence of 2.9 percent per year (32).

Since cervical fusion causes ADD (13-15), the advantage of TDR over cervical fusion is thought to lie in TDR's potential to "slow the rate of adjacent-level disease" (31). This is undoubtedly due to the preservation of flexibility in the TDR joint, as alternatively, fusion results in no motion at the fusion level with increased motion at the adjacent levels (33).

Any change in alignment of the cervical spine causes changes in its kinematics which in turn changes the biomechanical loading characteristics and altered motion in adjacent areas, this can accelerate its degeneration (3). In our opinion, the integrity of the normal cervical lordosis is key to a patient's long-term successful outcome following surgery.

What is the normal cervical lordosis? Harrison et al, from 400 normal subjects, proposed that a cervical lordosis should have minimum C2-C7 ARA of 34° (30,34), and suggest a range of 34-42° (30,34). They also state that "cervical surgical fusions should use 7-9° RRAs of extension" (34). This model has been validated by discriminant analysis of symptomatic and asymptomatic patients (8).

Since surgical goals are to re-establish enough lordosis from kyphosis/hypolordosis, there is also evidence that too much lordosis will also negatively affect kinematics (3) and long-term outcome in TDR procedures (31). Delamarter et al. determined that if in-operatively, a segmental cervical lordotic angle increases greater than 8° at the time of surgery, patients may have a less than optimal outcome including an increased risk of heterotopic ossification (30). Thus, as Harrison et al. propose, a segmental extension angle should be in the

range of 7-9°, not more or less as to match the normal/ideal cervical alignment (34). With these factors in mind, it would appear to be clinically prudent to improve a patient's lordosis pre-operatively and post-operatively with CBP cervical extension traction methods. This would ensure a more ideal lordosis configuration of the cervical spine at the time of surgery and also secure an ideal lordosis post-operatively to avoid long-term ADD and optimize patient outcomes.

CBP methods incorporated in the care of this patient included cervical extension traction as well as neck exercises, and instrument adjustments. Although there were 3 main treatments, it is primarily the extension traction and its viscoelastic creep deformation to the ligaments and discs over sustained traction periods that is attributed to the increase in lordosis (21). This is because instrument adjusting and exercises are not expected to improve physiologic cervical lordosis (36).

The patient failed to increase her cervical lordosis with generalized post-surgical physiotherapy treatment. This is consistent with the findings of Hillibrand et al. (32) who found that of those patients needing reoperation, two-thirds had failed 'nonoperative management.' We contend that most post-surgical rehabilitation approaches fail to re-establish the cervical lordosis. The unique cervical spine extension traction methods of CBP technique (21-26) may prove to be an effective compliment to cervical spine surgery affecting the intervertebral disc(s).

The 2.5 year follow-up indicated a loss of cervical lordosis. This provides rationale for the continued 'maintenance' treatment to preserve lordotic alignment. This is also consistent with several trials that display lordosis improvement after rehabilitation programs that show a slight loss of lordosis upon follow-up without continued treatment (21).

## CONCLUSION

As this case demonstrates, in patients who fail to progress with conservative therapy, cervical TDR is a viable option with advantages over fusion. Further, this combined approach of CBP methods and cervical TDR shows a promising future of cooperation between specialties. A significant improvement in the C5-C6 RRA segmental angle and ARA global cervical lordotic angle was achieved with a combined approach of cervical TDR and CBP methods applied to the surrounding soft tissue. This combined approach of cervical TDR and CBP was shown to be beneficial to this patient. The success of this case suggests the need for larger sample size and a prospective case series.

### Conflict of Interest

JOJ manufactures the UTS (Universal Tractioning Systems, LLC.), which was one of the devices used in this case report.; PAO is a paid consultant for CBP NonProfit, Inc.; DEH teaches chiropractic rehabilitation methods and sells products to physicians for patient care as used in this manuscript.

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