

# Artificial Cervical Disk Replacement at Three Levels Following Multilevel Cervical Discectomy

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## ABSTRACT

Cervical disk prolapse is a common ailment in young people and has generally been treated by anterior cervical discectomy and fusion. This has caused restricted movement of the neck at the level of fusion along with adjacent segment changes over a period of time. With the advent of artificial disk, motion preserving techniques are being used for young people with active lifestyles with excellent outcomes. Artificial disk replacement at single level has been used by many surgeons after cervical discectomy, however, a three level cervical disk replacement or cervical disk arthroplasty surgery has rarely been performed. We report a 46-year-old patient with symptomatic three level cervical disk prolapse treated with anterior cervical discectomy followed by artificial disk replacement at all three levels as a motion preserving surgery.

**Keywords:** Cervical disk prolapse, Disk replacement, Motion preserving.

**How to cite this article:** Shrivastav A, Mediratta S. Artificial Cervical Disk Replacement at Three Levels Following Multilevel Cervical Discectomy. *J Spinal Surg* 2017;4(2):79-82.

**Source of support:** Nil

**Conflict of interest:** None

## INTRODUCTION

Artificial disk replacement for multilevel cervical disks prolapse or spondylosis has been approved in the United States only in the last decade and has been used frequently by spine surgeons as a substitute for cervical disk replacement after discectomy in young patients as a motion preserving technique. Confronted with multilevel pathology and well-known morbidity and risk factors of the extensive fusion techniques<sup>1,2</sup>, some authors advocate for the multilevel disk replacement<sup>3-5</sup>. As per our literature search, there have been 27 reported cases of 3 or more levels of artificial cervical disk replacement in a single patient. This is the first reported case from India.

We describe the case of a patient who presented with cervical disk prolapse at three levels, underwent a three level cervical discectomy followed by an artificial disk replacement at all three levels.

## CASE REPORT

A 46-year-old male had presented with pain at the nape of neck with radiation of pain along both the upper limbs of 6 months duration. His pain had become worse over the last 2 months and had difficulty in performing activities of daily living without being bothered by the pain. There was no history of weakness of limbs or sensory loss. On examination, he had a normal upper and lower limb tone along with normal power in the shoulders, bilateral elbow extension had 4+/5 power, bilateral wrist and hand grip was 5/5. Both lower limbs had 5/5 power. He had diminished triceps reflex on both sides along with decreased pain and touch sensation in cervical (C) 6, 7 dermatome on the left side. The neck disability index (NDI) was 48. The visual analog scale (VAS) for the neck and upper limb was 6.2 and 7.9 respectively. The research organization 36-item short form health survey (SF-36) score for pain and social functioning was 32.5 and 25 respectively.

The patient was investigated with X-ray and a magnetic resonance imaging (MRI) scan of the cervical spine which revealed a cervical disk prolapse at C4/5, C5/6, and C6/7 with significant root compression as seen in Fig. 1.



**Fig. 1:** Magnetic resonance imaging of the cervical spine. T2-weighted (wt) saggital images showing disk prolapse at C4/5, C5/6, and C6/7 levels

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**Fig. 2:** X-ray of the cervical spine showing the three artificial disks *in situ*

The patient underwent an anterior cervical approach and cervical discectomy at C4/5, C5/6, and C6/7 followed by an artificial disk replacement at all three levels.

The cartilaginous endplates were thoroughly removed after completing the discectomy. The endplates were fashioned with a high-speed drill and made parallel. Bilateral wide foraminotomies were performed. The implant trial was fit snug but not under too much tension and no more than 1 to 2 mm from midline. Once the implant was inserted and secured, under fluoroscopic guidance the head was flexed and extended to evaluate motion. The procedure lasted 3 hours. He was mobilized 24 hours after the surgery and discharged after 3 days of hospital stay. He had significant relief of his neck and radicular pain and operative site pain was well-controlled on oral analgesics. Prior to his discharge, an X-ray of the cervical spine was done to check for the alignment of the implants (Fig. 2).

He was advised to discontinue the cervical collar 1 week after the discharge once the local operative site pain subsided. Patient was reviewed 6 weeks after surgery, scores improved in the postoperative period, and the NDI improved to 10 indicating mild limitation. The VAS for the neck and upper limbs was 0.5 and 0.7 respectively. The RAND SF-36 score for pain and social functioning was 77.5 and 77 respectively.

## DISCUSSION

The most common and successful surgical procedure for treatment of symptoms caused by cervical disk herniation is the anterior cervical discectomy and fusion (ACDF), first described by Smith and Robinson<sup>6</sup> and by Cloward<sup>7</sup> in the 1950s and has been the gold standard surgical treatment for degenerative disk disease for decades.<sup>8</sup> However, there is now an increasing concern about adjacent segment degeneration (ASD) which may result in additional surgical procedures.<sup>9</sup> Levels adjacent

to a cervical fusion may experience increased stress that contribute to degeneration.<sup>9,10</sup> Cummins in the 1980s introduced a simple ball and socket type of cervical joint to maintain motion in the cervical spine after discectomy. In a small case series, Cummins et al<sup>11</sup> demonstrated that cervical arthroplasty was safe, effective, and preserved segmental motion. In addition, he introduced the exciting concept of multilevel arthroplasty as an alternative to multilevel fusion.<sup>10,11</sup>

In single level subaxial fixation, the cervical spine is able to compensate and maintain overall motion. However, as more levels are incorporated into the construct, cervical motion is adversely affected. Levels adjacent to a cervical fusion may experience increased stressors that contribute to degeneration.<sup>10,12-14</sup> Hilibrand et al<sup>15</sup> have reported symptomatic adjacent disease occurs at a rate of 2.9% per year in patients undergoing ACDF. Although, the natural progression of degenerative disk disease must be a contributing factor, the work by Goffin et al<sup>16</sup> demonstrated that adjacent segment disease is more likely related to the arthrodesis.

Lawrence et al<sup>17</sup> found the prevalence of adjacent segment pathology to the range from 11 to 12% at 5 years, 16 to 38% at 10 years, and 33% at 17 years. They also showed that the mean rate of development for symptomatic degeneration in the cervical spine after arthrodesis is estimated between 1.6 and 4.2% per year, and the mean rate of reoperation for clinical adjacent level pathology is estimated at 0.8% per year.<sup>17,18</sup>

In surgical treatment of multilevel cervical degenerative disk disease, the place of multilevel cervical disk replacement (CDR) in the continuum of care is gaining credibility. Despite the short-term outcomes documented, the increasing acceptance of CDR is supported by the concept that maintaining treated segment and cervical spine mobility could achieve better protection of adjacent segments, compared to fusion.<sup>3</sup> While cervical disk arthroplasty (CDA) may not entirely prevent ASD, the advancement of the radiographic degeneration is slowed by CDA.<sup>5</sup>

According to the current standards of care for CDR, it has been estimated that cervical arthroplasty procedure would be performed in 43% of the patients who require surgery for degenerative pathology of the cervical spine.<sup>18</sup> A number of biomechanical studies suggest that cervical arthroplasty mimics natural cervical motion at the operated level while ACDF does not.<sup>12,19,20</sup>

Several case series have demonstrated that multilevel cervical arthroplasty for the treatment of radiculopathy and myelopathy can be an alternative with good outcomes.<sup>5,10,21</sup> In a prospective study, Pimenta et al<sup>4</sup> demonstrated that multilevel cervical arthroplasty had improved outcomes over single level arthroplasty when

comparing NDI and VAS scores. Several clear advantages to performing multilevel cervical arthroplasty are preserved motion, decreased adjacent level biomechanical stressors, and potentially better outcomes.

The indication for a multilevel CDR is degenerative disk disease between cervical (C) 3 and thoracic (T) 1 leading to radiculopathy or myelopathy. Since, our patient was relatively young and had an active lifestyle, he did not want a fusion procedure for his multilevel cervical disk disease, he was thus offered multilevel ADR. The contraindications are usually age beyond 65, loss of segmental mobility resulting from spondylotic osteophytes or facet degeneration at the index levels, segmental instability (>3 mm translation or >15° of angular motion), collapse of disk space by more than 50% of its normal height, osteoporosis, metabolic bone disease, congenital or post traumatic deformity, infection, neoplasia or a narrow canal (<12 mm). Previous cervical spine surgery including surgery at the index level is not considered a contraindication<sup>3,8</sup>

During surgery, it is imperative to make the adjacent end-plates parallel using a high-speed drill and not to violate the subchondral bone, as this weakens the fixation of the implants. Performing wide foraminotomies will prevent foraminal encroachment during motion<sup>10</sup> The implant should fit snug without tension and no more than 1 to 2 mm from the midline due to the theoretical risk of uneven facet loading and potential postoperative pain as well as potential for advanced facet arthrosis. Once the implant is fixed, evaluate the range of motion under fluoroscopic guidance by flexing and extending the head.<sup>10</sup> Failure of the cervical disk arthroplasty has been reported due to poor patient selection, inadequate preoperative planning, suboptimal surgical technique, malpositioning of the device, and device migration. These have resulted in revision surgeries.<sup>18</sup>

Multilevel anterior cervical surgery is associated with a higher local complication rate, such as dysphagia and dysphonia when compared with a single level surgeries, these are attributed to the extent of surgical exposure.<sup>3,22,23</sup>

Another major concern about multilevel CDA is heterotopic ossification (HO). Different series have reported varied figures for HO. Cardoso and Rosner<sup>10</sup> during a 12 months follow-up reported no cases of HO where as Wu et al<sup>8</sup> at 24 months follow-up showed an incidence of 66%, however, the HO did not affect the clinical outcome and 97.7% of the artificial disks remained mobile despite HO. Davis et al<sup>5</sup> at 48 months reported 25.6% HO while Radclif et al<sup>24</sup> reported a 29.7% rate of HO at 60 months follow-up with preserved range of motion in the arthroplasty patients. Though, the presence of HO have not affected the clinical outcomes or limit the

mobility of the artificial disks, so far, further investigation is needed to assess the long-term effects of HO.

Davis et al<sup>5</sup> over a 48 months follow-up compared ACDF with CDA for two level disease and reported statistically significant improvement in NDI scores, 12 item short form (SF-12) health survey physical component scores, patient satisfaction and overall success. The ACDF patients experienced higher subsequent surgery rates and displayed a higher rate of ASD as seen on radiographs. The CDA patients maintained segmental range of motion through 48 months. This available data show patients' experience improvement in clinical outcomes with CDA including improvement in pain and function outcomes with superiority in overall primary end point success.

## CONCLUSION

Current literature supports the use of CDA in multilevel disease in selected patients. Multilevel cervical arthroplasty is a safe and effective alternative to fusion for the management of cervical disk disease.

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