Clinical Neurology and Neurosurgery 162 (2017) 59–66

Contents lists available at ScienceDirect

Clinical Neurology and Neurosurgery

journal homepage: www.elsevier.com/locate/clineuro

Original article

Cervical arthroplasty versus anterior cervical fusion for symptomatic adjacent segment disease after anterior cervical fusion surgery: Review of treatment in 41 patients

Sang-Bok Lee, Kyoung-Suok Cho*

Department of Neurosurgery, Uijeongbu St. Mary's Hospital, College of Medicine, The Catholic University of Korea, Seoul, Republic of Korea

ARTICLE INFO

Keywords:
Cervical spine
Arthroplasty
Adjacent segmental disease
Anterior cervical fusion and discectomy

ABSTRACT

Objective: The purpose of this study is to compare the efficacy and safety of anterior cervical discectomy and fusion (ACDF) and cervical total disc replacement (CTDR) as revision surgeries for symptomatic adjacent segment degeneration (ASD) in cases with previous ACDF.

Patients and methods: Between 2010 and 2014, 41 patients with previous cervical fusion surgery underwent ACDF or CTDR for symptomatic ASD. Twenty-two patients in the ACDF group underwent 26 ACDFs, and 19 patients in the CTDR group underwent 25 arthroplasties for symptomatic ASD. Clinical outcomes were assessed by a visual analogue scale (VAS) for arm pain, the neck disability index (NDI) and Odom's criteria. Radiological evaluations were performed preoperatively and postoperatively to measure changes in the range of motion (ROM) of the cervical spine and adjacent segments and arthroplasty level. The radiological change of ASD was assessed in radiographs.

Results: Clinical outcomes as assessed with VAS for arm pain and Odom's criteria were significantly improved in both groups. The CTDR group showed better NDI improvement after surgery ($P < 0.05$). The mean C2-7 ROM of the CTDR group revealed faster recovery than did that of the ACDF group and the preoperative values were recovered at the last follow-up visit. There was a significant difference in the ROM of the inferior adjacent segment between the ACDF and CTDR groups ($P < 0.05$). The ACDF group had a higher incidence of radiological changes in the adjacent segment compared with the CTDR group ($P < 0.05$).

Conclusions: The 2-year clinical results of CTDR for symptomatic ASD are safe and are comparable to the outcomes of ACDF in terms of arm pain relief and functional recovery. The CTDR group showed better NDI improvement, faster C2-7 ROM recovery, less of an increase in ROM in the inferior adjacent segment, and a lower incidence of adjacent segment degeneration than did the ACDF group.

1. Introduction

Anterior cervical discectomy and fusion (ACDF) for the treatment of degenerative cervical disease has produced successful clinical outcomes with a high fusion rate (80–90%) using autologous iliac crest bone grafts [1–4]. In spite of the success of this procedure, a frequently recognized potential complication is the accelerated degeneration of adjacent segment disc levels, also termed adjacent segment disease (ASD) [5]. Subsequently, the same disease was described in the cervical spine after ACDF [5,6]. ASD may occur as a result of excessive motion and stress because of biomechanical changes at levels adjacent to a fused segment [7–9]. In one study, symptomatic ASD was detected in 25.6% of patients who underwent ACDF. Among them, additional surgery was required in about half of the patients who failed conservative treatment [10].

Other reports in the literature have described surgical outcomes following the treatment of a symptomatic adjacent level following fusion surgery. In one study, the fusion rate was significantly lower (63%) than seen with primary ACDF when ACDF was performed adjacent to a prior fusion [6].

Additionally, significant loss of normal cervical range of motion (ROM) did occur. It is possible that consecutive two-level fusion may give rise to excessive motion and accentuate the degeneration of the remaining mobile segment. For this reason, a motion preservation procedure (arthroplasty) for the treatment of symptomatic ASD following previous fusion surgery could be a good alternative procedure. Recent prospective randomized studies have demonstrated that primary CTDR produces favorable

* Corresponding author at: Department of Neurosurgery, Uijeongbu St. Mary's Hospital, College of Medicine, The Catholic Univ. of Korea, 271, Cheonbo-Ro, Uijeongbu-si, Gyeungi-do, 11765, Republic of Korea.
E-mail address: leesb@catholic.ac.kr (K.-S. Cho).

http://dx.doi.org/10.1016/j.clineuro.2017.08.001
Received 10 February 2017; Received in revised form 31 July 2017; Accepted 3 August 2017
Available online 04 August 2017
0303-8467/

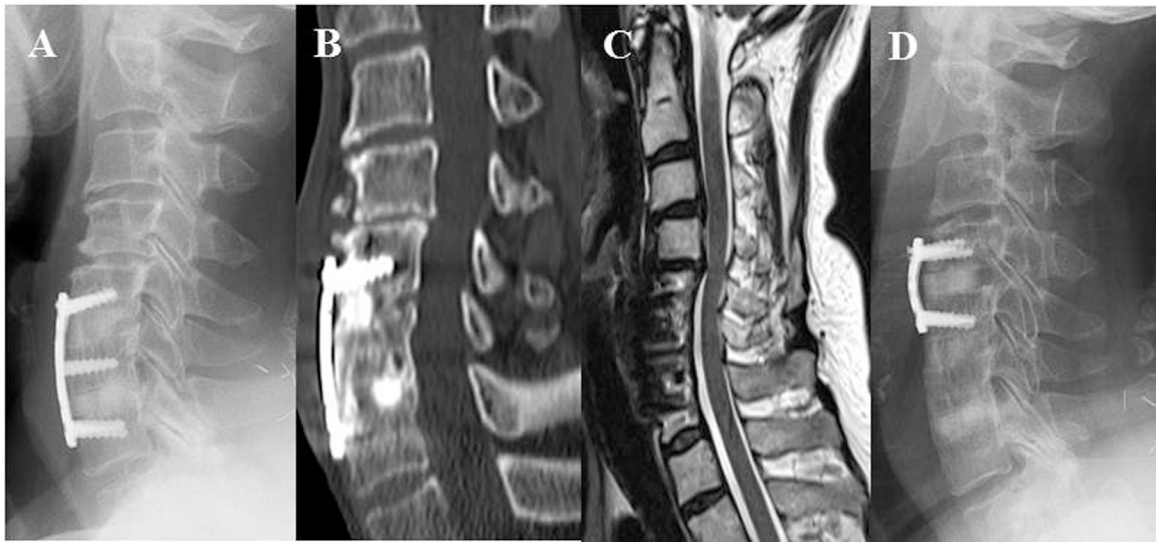

Fig. 2. Surgical indication of ACDF for symptomatic ASD.
A 54-year-old woman developed upper level adjacent segment disease 8 years after primary C5/C6/C7 ACDF. Preoperative lateral radiograph (A) and CT scan (B) indicate intervertebral disc space narrowing, anterior bony spur and retrolisthesis at C4/C5 level. Sagittal T2 MR image (C) indicates disc herniation at C4/C5 level. Postoperative lateral radiograph (D) shows ACDF at C4/C5.

outcomes concerning pain, neurologic outcomes, and return to work compared to ACDF [11–13]. Additionally, comparisons of clinical outcomes and biomechanical parameters associated with two-level fusion versus hybrid surgery consisting of ACDF and CTDR using the neck disability index (NDI) and visual analog scale (VAS) score for arm and neck pain have revealed significant improvement in the hybrid group and hypermobility of the adjacent level in the two-level fusion group compared to the hybrid surgery [14,15]. These results suggest the potential clinical and biomechanical advantages of ACDF-CTDR hybrid surgery.

The purpose of this study was to compare the clinical and radiologic outcomes of additional CTDR or ACDF for symptomatic ASD after a previous ACDF.

2. Materials and methods

2.1. Patient selection

Between 2010 and 2014, 41 patients who had previously received cervical fusion surgery underwent ACDF or CTDR adjacent to the initial fusion level at our hospital. We retrospectively analyzed the records of these 41 patients after gaining approval from the Institutional Review Board of our hospital. All 41 patients were observed clinically and radiologically for more than 2 years after their second operation. Adjacent segmental disease was defined as the presence of newly developed clinical symptoms that corresponded with neural compression at levels adjacent to a previous fusion site. Surgical indications were a diagnosis of symptomatic ASD and radicular or mild myelopathic symptoms refractory to conservative treatments for a minimum of 6 weeks. Selection of ACDF or CTDR for symptomatic ASD was made using preoperative dynamic radiographs and cervical spine computed tomography (CT) scanning. In cases in which target levels were mobile and non-spondylotic segments, CTDR was performed (Fig. 1). On the other hand, if there was no motion, instability, presence of facet degeneration, or gross bony spur at the target level, CTDR was excluded and ACDF was performed (Fig. 2). The exclusion criteria of ACDF and CTDR were determined as follows: 1) cervical stenosis caused by

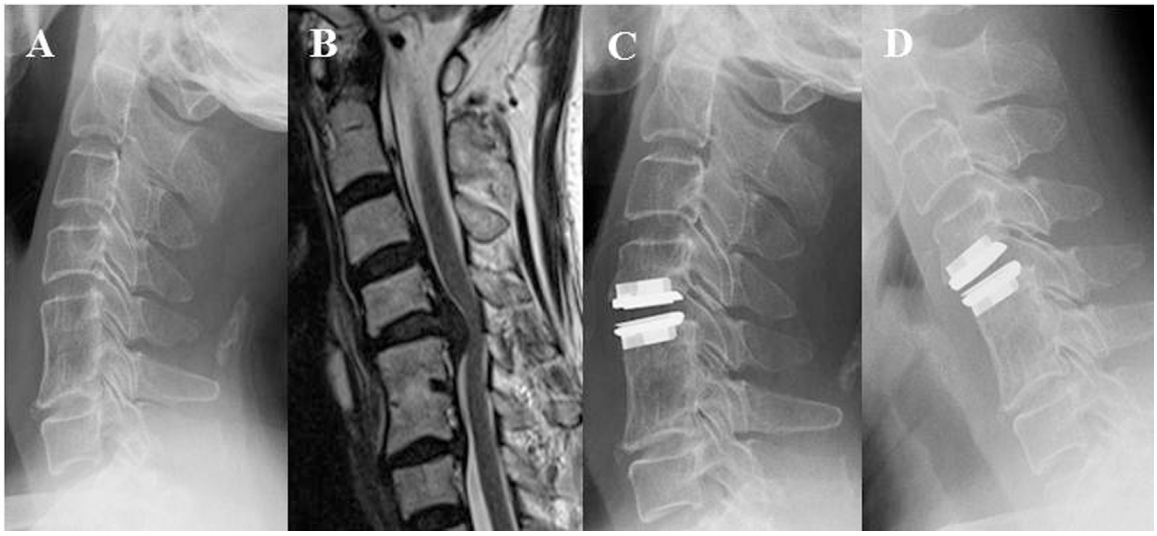

Fig. 1. Surgical indication of CTDR for symptomatic ASD.
A 56-year-old man developed upper level adjacent segment disease 11 years after primary C5/C6 ACDF with iliac bone. Disc space at C4/C5 level is well preserved and no osteophyte was observed on lateral radiograph (A). Sagittal T2 MR image (B) shows a large disc herniation with cord compression. Postoperative extension and flexion lateral radiographs (C and D) show the placement of Prodisc-C at C4/C5 level. Note that motion is preserved with the disc shell tilting at treated levels in flexion and extension.