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Revision surgeries following artificial disc replacement of cervical spine

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ABSTRACT

Objective: We investigated causes and results of revision surgeries after artificial disc replacement of cervical spine (C-ADR).
Methods: Twenty-one patients (mean age: 52.8) who underwent revision surgery after C-ADR and who had a minimum 2-year of follow-up were included into this study. The mean time between the primary and revision surgeries was 21 months. During their primary surgeries, 14 patients underwent single level C-ADR, 2 two-level C-ADR, and 5 two-level hybrid surgery for 16 radiculopathy, 3 myelopathy, and 2 adjacent segment diseases. Causes for revision surgeries were at least one of the followings: 17 poor patient selections, 7 insufficient decompressions, 7 malpositions, 6 subsidences, 3 osteolysis, and 1 postoperative infection.
Results: Sixteen patients underwent anterior removal of C-ADR, one-level discectomy and fusion (N = 11), two-level discectomy (N = 3) or one-level corpectomy (N = 2) and fusion. Three patients of keel type C-ADR with heterotopic ossification underwent posterior laminoforaminotomy and fusion. Two patients underwent combined procedures due to infection or severe subsidence and osteolysis. At the 2-year follow-up, neck (7.3 vs 1.6) and arm (7.0 vs 1.3) visual analog scales and Neck Disability Index score (46.7 vs 16.32) were improved (all, $p < 0.05$). According to Odom's criteria, 86% of the patients were satisfied and 91% achieved solid fusion. No major complications developed except for transient dysphagia in 6 patients (29%).
Conclusions: In this small case series, revision surgeries provided successful outcomes in failed C-ADR without major complications. Careful patient selection and meticulous surgical techniques are important to avoid disappointing clinical outcome or even failure of C-ADR.
Level of evidence: Level IV, Therapeutic study.

Introduction

Artificial disc replacement of cervical spine (C-ADR) has been developed to maintain range of motion at operated segment to avoid development of adjacent segment disease (ASD) due to anterior cervical discectomy fusion (ACDF).[1–3] Another goal of C-ADR is to achieve satisfactory outcomes for cervical radiculopathy or myelopathy caused by soft disc herniation or mild spondylosis.[4,5] Many previous studies have reported successful clinical outcomes and maintenance of segmental motion of various types of C-ADR.[6,7] However, some patients also have undergone revision surgeries after C-ADR surgeries including persistence or recurrence of symptoms and complications.

Revision surgeries after C-ADR is technically demanding and regardless of types and designs of C-ADR, previous study on primary C-ADR have resulted in higher rate of revision surgeries compared to ACDF.[8–10] In addition, revision surgeries after C-ADR

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are reportedly associated with greater hospital costs, longer length of hospital stay, and complications.[8] Increasing implantation rates of C-ADR may lead to an increase in revision procedures. However, previous studies were coding data analyses limited to nationwide inpatient sample of USA, but not studies of clinical case series. Therefore, little information is available about clinical and radiological results of revision surgeries after C-TDR. Therefore, it is important to evaluate clinical and radiological outcomes of revision surgeries so as to decide decision-making strategy. In addition, it is essential to investigate causes of failure of C-ADR surgeries to avoid revision surgeries. We performed the current study to investigate these two issues.

Table 1
Summary of demographic data, clinical and radiological results.

No.	Sex	Age	C-ADR device	Failure level(s)	Time to revision surgery (months)	Revision surgery approach	Overall satisfaction (Odom's criteria)	Fusion status
1	F	43	Prodisc-C	C5-6, C6-7	20	Posterior	Good	Fusion
2	F	48	Prodisc-C	C5-6, C6-7	34	Posterior	Good	Fusion
3	F	58	Mobi-C	C5-6	27	Anterior	Fair	Pseudoarthrosis
4	M	55	Bryan	C4-5, C5-6	18	Anterior	Good	Fusion
5	M	57	Discocerv	C5-6, C6-7	5	Anterior	Good	Fusion
6	F	53	Prodisc-C	C4-5, C5-6	6	Anterior	Good	Fusion
7	M	43	Mobi-C	C5-6, C6-7	6	Anterior	Good	Fusion
8	M	63	Prestige LP	C5-6, C6-7	13	Posterior	Fair	Fusion
9	M	61	Discocerv	C5-6	18	Combined	Good	Fusion
10	M	53	Mobi-C	C4-5	84	Anterior	Excellent	Fusion
11	M	48	Mobi-C	C5-6	25	Anterior	Good	Fusion
12	M	55	Discocerv	C5-6, C6-7	21	Anterior	Good	Fusion
13	F	52	Prestige LP	C6-7	8	Anterior	Excellent	Fusion
14	M	55	Discocerv	C6-7	4	Combined	Fair	Fusion
15	M	53	Mobi-C	C4-5	20	Anterior	Good	Fusion
16	F	59	Mobi-C	C5-6	17	Anterior	Good	Fusion
17	M	50	Bryan	C6-7	32	Anterior	Good	Fusion
18	M	48	Discocerv	C5-6	22	Anterior	Good	Pseudoarthrosis
19	F	55	Mobi-C	C5-6	10	Anterior	Good	Fusion
20	M	51	Mobi-C	C6-7	16	Anterior	Excellent	Fusion
21	F	49	Discocerv	C5-6	23	Anterior	Good	Fusion

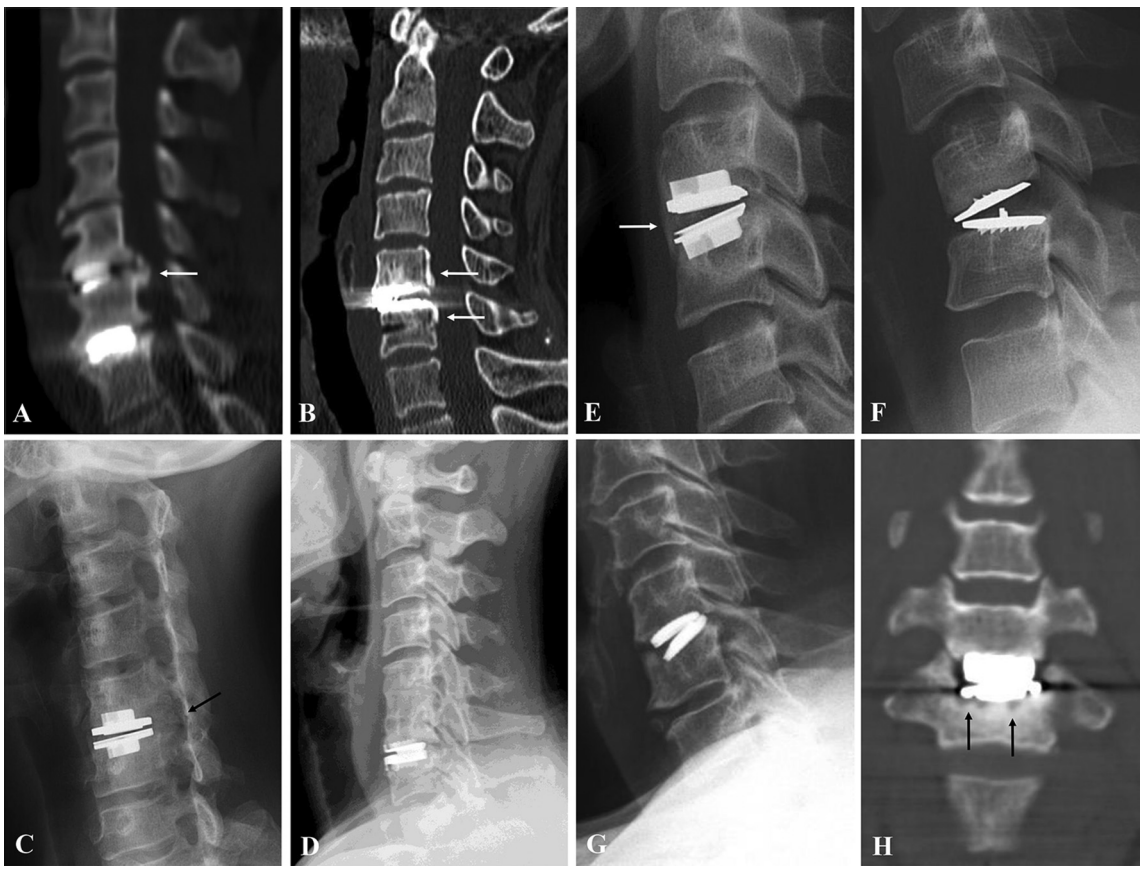

Fig. 1. Causes of failure of artificial disc replacement of cervical spine: severe spondylosis (white arrow) (**A**), ossification of posterior longitudinal ligament (white arrows) (**B**), Foraminal stenosis (black arrow) (**C**), severe spondylosis adjacent to previous fusion (**D**), hyperlordotic positioning with heterotopic ossification (white arrow) (**E**), kyphotic positioning (**F**), subsidence (**G**), and osteolysis (black arrows) (**H**).

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