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MINI-REVIEW

Cervical total disc replacement

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Summary Cervical total disc replacement (CTDR) has been accepted as a viable option for surgical management of cervical spondylosis or degenerative disc disease. Current indications for CTDR are one- and two-level cervical spondylosis and degenerative disc disease causing radiculopathy or myelopathy that is refractory to medical treatment. Conventionally, these patients could be managed surgically with anterior cervical discectomy and fusion (ACDF) as the standard of care. In recent years, there have been several large-scale, prospective, randomized, and controlled clinical trials that have demonstrated similarly excellent clinical outcomes of both CTDR and ACDF for one-level cervical degenerative disc disease with 5 years of follow-up. Because CTDR allows preservation of segmental motion of the spine and has the potential to reduce the risk of adjacent segment disease (ASD), it has gained popularity in recent years. However, the surgical technique of CTDR is more demanding, and associated complications have been reported. Furthermore, the true effect of CTDR on the incidence of ASD remains uncertain. Therefore, further investigations are required to corroborate favorable long-term results, and whether CTDR can reduce the risk of ASD. Appropriate patient selection and accurate surgical techniques remain the fundamentals of a successful CTDR. The currently available data suggest that CTDR is a safe and effective alternative to ACDF to treat patients with cervical spondylosis or degenerative disc disease and meet the criteria of clinical trials.

Conflicts of interest: The author report no conflicts of interest concerning the materials or methods used in this study or the findings specified in this paper.

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1. Rationale

Anterior cervical discectomy and fusion (ACDF) has been accepted as the gold standard of surgical management for cervical spondylosis and disc disease causing radiculopathy or myelopathy. High patient-satisfaction scores and high arthrodesis rates associated with ACDF have been reported in the literature.[1] However, there is always the concern of loss of segmental motion at the index level of the intervertebral disc after ACDF. Furthermore, adjacent segment disease (ASD) has been reported after cervical fusion at a rate of 2.9% per year.[2] This development of ASD may also cause symptoms that require re-operations.[2–4] A study from Taiwan, covering 19,385 patients who underwent ACDF over a period of 11 years, estimated the incidence of ASD that required a repeat ACDF operation to be 0.8% annually.[4] Although the actual etiology of re-operation for ASD after ACDF is still uncertain, it can be attributed to the natural course of spondylosis or a consequence of increased load after neighboring arthrodesis. Wu et al reported that, in Taiwan, after ACDF, a considerable portion (i.e., 5.6%) of patients had a second ACDF during the following 10 years.[4]

In recent years, there has been an emerging option of cervical total disc replacement (CTDR) for surgical management of disc disease in the cervical spine. The development of CTDR intends to preserve motion and reduce ASD. By implantation of an artificial disc instead of a bone graft after cervical discectomy, the technology of CTDR allows preservation of spinal motion at the indexed intervertebral disc (Fig. 1). In theory, maintaining the segmental motion at the indexed disc level translates little workload to the neighboring discs and might thus reduce the incidence of ASD. From reports of short- to mid-term (i.e., 2–5 years) follow-up, the average range of motion at the index level was successfully preserved at approximately 8° after CTDR.[5–8] However, the reduction in ASD or avoidance of a second surgical procedure for ASD was uncertain in these reports. Whether ASD could be ameliorated still needs data from long-term follow-up to validate.

2. Clinical trials

There are several prospective, randomized, controlled, multicenter clinical trials, approved by the U.S. Food and Drug Administration (FDA) investigational device exemption (IDE), comparing CTDR with ACDF for single-level cervical disc disease with more than 2–5 years of follow-up.[5–7,9,10] These trials have analyzed outcomes of a number of artificial disc devices (e.g., BRYAN, Prestige ST, ProDisc-C, and Kineflex|C) with a comparison to instrumented ACDF in the management of one-level cervical disc disease. All these trials have applied similar inclusion and exclusion criteria, used similar radiological and clinical outcome measurements, and had their data published in major journals.

3. Indications

The inclusion criteria of the aforementioned FDA-IDE trials for CTDR were adult patients with single-level symptomatic cervical spondylosis and disc herniation at C3–C7 levels who presented with intractable radiculopathy, myelopathy,

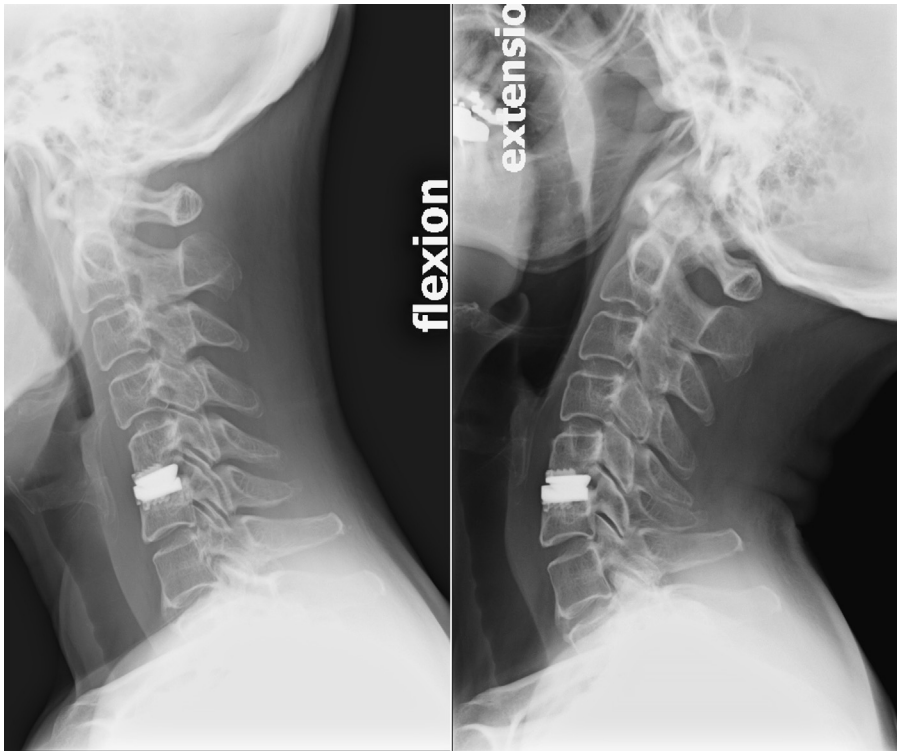

Figure 1 Postoperative dynamic radiographs. The patient underwent cervical total disc replacement for a herniated disc causing cervical radiculopathy. Postoperative lateral radiographs demonstrated the preserved segmental motion at C5/C6.