Hybrid Corpectomy and Disc Arthroplasty for Cervical Spondylotic Myelopathy Caused by Ossification of Posterior Longitudinal Ligament and Disc Herniation

Huang-Chou Chang[5], Tsung-Hsi Tu[1,2], Hsuan-Kan Chang[1,2], Jau-Ching Wu[1-3], Li-Yu Fay[1,2], Peng-Yuan Chang[1,2], Ching-Lan Wu[2,4], Wen-Cheng Huang[1,2], Henrich Cheng[1-3]

■ OBJECTIVE: **The combination of anterior cervical discectomy and fusion (ACDF) and anterior cervical corpectomy and fusion (ACCF) has been demonstrated to be effective for multilevel cervical spondylotic myelopathy (CSM); however, the combination of ACCF and cervical disc arthroplasty (CDA) for 3-level CSM has never been addressed.**

■ METHODS: **Consecutive patients (>18 years of age) with CSM caused by segmental ossification of posterior longitudinal ligament (OPLL) and degenerative disc disease (DDD) were reviewed. Inclusion criteria were patients who underwent hybrid ACCF and CDA surgery for symptomatic 3-level CSM with OPLL and DDD. Medical and radiologic records were reviewed retrospectively.**

■ RESULTS: **A total of 15 patients were analyzed with a mean follow-up of 18.1 ± 7.42 months. Every patient had hybrid surgery composed of 1-level ACCF (for segmental-type OPLL causing spinal stenosis) and 1-level CDA at the adjacent level (for DDD causing stenosis). All clinical outcomes, including visual analogue scale of neck and arm pain, Neck Disability Index, Japanese Orthopedic Association scores, and Nurick scores of myelopathy, demonstrated significant improvement at 12 months after surgery. All patients (100%) achieved arthrodesis for the ACCF (instrumented) and preserved mobility for CDA (preoperation 6.2 ± 3.81° vs. postoperation 7.0 ± 4.18°; $P = 0.579$).**

■ CONCLUSIONS: **For patients with multilevel CSM caused by segmental OPLL and DDD, the hybrid surgery of ACCF and CDA demonstrated satisfactory clinical and radiologic outcomes. Moreover, although located next to each other, the instrumented ACCF construct and CDA still achieved solid arthrodesis and preserved mobility, respectively. Therefore, hybrid surgery may be a reasonable option for the management of CSM with OPLL.**

INTRODUCTION

Cervical spondylotic myelopathy (CSM), usually caused by degenerative disc disease (DDD) or ossification of posterior longitudinal ligament (OPLL), is a common cause of myelopathy in patients older than 55 years of age.[1,2] Patients are at high risk of neurologic deterioration or spinal cord injury when managed with nonoperative strategies.[3,4] In contrast, surgical intervention could yield better neurologic function and reduce the risk of spinal cord injury[1,5-14]; however, there are multiple options

Key words
- Anterior cervical corpectomy and fusion
- Cervical disc arthroplasty
- Cervical spondylotic myelopathy
- Hybrid
- Ossification of posterior longitudinal ligament

Abbreviations and Acronyms
ACCF: Anterior cervical corpectomy and fusion
ACDF: Anterior cervical discectomy and fusion
ASD: Adjacent-segment degeneration
CDA: Cervical disc arthroplasty
CSM: Cervical spondylotic myelopathy
CT: Computed tomography
DDD: Degenerative disc disease
FDA-IDE: Food and Drug Administration investigational device exemption
FS: Fusion surgery
HC: Hybrid construct
JOA: Japanese Orthopedic Association
MRI: Magnetic resonance imaging
NDI: Neck Disability Index
OPLL: Ossification of posterior longitudinal ligament
ROM: Range of motion
VAS: Visual analogue scale

From the [1]Department of Neurosurgery, Neurological Institute, Taipei Veterans General Hospital, Taipei; [2]School of Medicine, National Yang-Ming University, Taipei; [3]Institute of Pharmacology, National Yang-Ming University, Taipei; [4]Department of Radiology, Taipei Veterans General Hospital, Taipei; and [5]Department of Surgery, Kaohsiung Veterans General Hospital, Kaohsiung, Taiwan

To whom correspondence should be addressed: Jau-Ching Wu, M.D., Ph.D. [E-mail: jauching@gmail.com]

Citation: World Neurosurg. (2016) 95:22-30.
http://dx.doi.org/10.1016/j.wneu.2016.07.065

Journal homepage: www.WORLDNEUROSURGERY.org

Available online: www.sciencedirect.com

of surgical management for multilevel CSM with or without OPLL, including anterior cervical discectomy and fusion (ACDF), anterior cervical corpectomy and fusion (ACCF), posterior laminectomy and arthrodesis with or without instrumentation, and posterior laminoplasty. There has been a classic debate about the choices between anterior and posterior approaches for decompression.[1,15,16]

For multilevel CSM caused by OPLL, anterior decompression (e.g., ACCF), provides several advantages over posterior approaches. For instance, ACCF yields direct decompression of the ventral pathology, particularly of the OPLL, which frequently causes spinal cord compression,[17] enables the reconstruction of the cervical lordotic alignment with anterior column support,[16] avoids subsequent kyphosis possibly related to posterior destruction of the tension band, delayed neurologic deterioration,[18-21] and permits the easy restoration of cervical stability through instrumented arthrodesis.[16,22,23] There are disadvantages of multilevel ACDF or ACCF, however, including neck stiffness, hoarseness and dysphagia, incidental durotomy and subsequent pseudomeningocele, and the likelihood of increasing the incidence of adjacent-segment degeneration (ASD).[24-29]

During the past decade, the newly introduced cervical disc arthroplasty (CDA) gradually has become popular. Reports of several prospective, randomized, and controlled trials of the U.S. Food and Drug Administration investigational device exemption (FDA-IDE) demonstrated that CDA was feasible and effective for 1- or 2-level symptomatic cervical DDD or spondylosis.[30-41] Furthermore, there have been studies that have demonstrated the effectiveness of using CDA for cervical myelopathy.[42-49] A number of series also demonstrated that a combination of CDA and ACDF for multilevel DDD might preserve neck mobility and lower the risk of ASD.[50-56] Scant data exist, however, on CDA with a neighboring ACCF construct. In such a hybrid construct (HC), the mobility of CDA next to an ACCF has remained elusive. The rate of successful arthrodesis after ACCF also has remained uncertain.

This study aimed to evaluate the efficacy and safety of using an HC (i.e., CDA and ACCF) to manage patients with segmental-type OPLL and DDD at different levels. The mobility of CDA, rate of arthrodesis in ACCF, and neurologic improvement after anterior decompression were evaluated. This was the first study to combine 1-level CDA and 1-level ACCF for the management of patients with DDD and OPLL.

METHODS

Inclusion of Patients

From 2011 to 2014, consecutive adult patients (age >18 years of age) who received subaxial (C3–7) hybrid 1-level ACCF and CDA surgery for contiguous 3-level CSM with OPLL were reviewed retrospectively. Preoperative magnetic resonance imaging (MRI) was obtained and reviewed for all patients. Every patient also had preoperative computed tomography (CT) scans for confirmation of the diagnosis of OPLL and for the overall planning of the surgery.

The inclusion criteria were patients who had symptomatic CSM caused by DDD and OPLL with spinal stenosis at 3 levels of the subaxial cervical spine. The surgery was anterior corpectomy and discectomy with subsequent reconstruction by the hybrid strategy. The HC consisted of 1-level ACCF after resection of the OPLL and 1-level CDA after discectomy for DDD or spondylosis at the neighboring levels. All included patients had undergone at least 12 weeks of nonoperative treatment before surgery.

Every patient had hybrid ACCF and CDA. The ACCF was performed at the level of cervical canal stenosis caused by OPLL, which was demonstrated on preoperative CT scans and MRI. The CDA was done at the other level of stenosis caused by DDD. Patients with continuous-type OPLL that extended above C2 or below C7 were excluded. Furthermore, the indication of CDA included radiculopathy, myelopathy, or both, caused by DDD or spondylosis[30-32,34,36-39,42] (**Figures 1–4**). The contraindications of CDA were 1) traumatic spinal cord injury or fracture; 2) evident segmental instability (i.e., more than 3.5 mm translation or 20° angular motion) at the indexed level; 3) segmental arthrodesis without mobility (i.e., less than 2° range of motion [ROM] on lateral flexion and extension radiography); 4) severely incompetent facet joints at the index level on preoperative CT scans; 5) adjacent segment disease after previous cervical fusion; 6) OPLL at the index level of CDA; 7) kyphotic deformity; 8) presence or history of discitis; or 9) long-term steroid user. Patients with severe osteoporosis, malignancy, metabolic bone disease, spondyloathropathy such as rheumatoid arthritis, infection, and severe systemic disease, such as stroke, also were excluded from the current study.

Measurement of Radiologic and Clinical Outcomes

Every patient's preoperative MRI and CT scans were evaluated for appropriate surgical indication. Standard anteroposterior, lateral, and dynamic (flexion and extension) lateral radiographs were taken preoperation, within 5 days postoperation, and at 3, 6, 12, and 24 months postoperation. Whether arthrodesis was achieved for the 1-level ACCF was determined by dynamic lateral radiographs at 12-month postoperative follow-up. The ROM of CDA at the index level was measured on dynamic lateral radiographs preoperatively as well as postoperatively at the last clinic follow-up with the Cobb method, similar to the previous FDA-IDE trial.[30] The digitalized images were examined with PACS system software, SmartIris (Taiwan Electronic Data Processing Co., Taipei Hsien, Taiwan) on a medical-use screen by independent radiologists and neurosurgeons.

Standardized clinical outcome measurements, including visual analogue scale (VAS), Neck Disability Index (NDI) scores, Nurick scores, and Japanese Orthopedic Association (JOA) scores, were collected before the operation and at each time point of follow-up postoperation. Clinical outcome scales were collected by one "Clinical outcome scales were collected by one physician assistant, assigned specifically for data collection and patient follow-up, under the physicians' supervision during clinic visits". The Nurick scores were collected for a quantifiable evaluation of the severity of myelopathy, and were also recorded at each time point for future comparison.

Surgical Technique

All the surgeries were performed by 3 experienced neurosurgeons and senior authors in this study (J.C.W., W.C.H., and H.C.). Similar surgical techniques of corpectomy and disc arthroplasty were used for every patient in the present study. The patient was placed in a supine position under general anesthesia.