Surgeries for Patients with Tandem Spinal Stenosis in Cervical and Thoracic Spine: Combined or Staged Surgeries?

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■ BACKGROUND: **Cervical and thoracic tandem spinal stenosis (ct-TSS) is a rare yet challenging degenerative disease. When the diagnosis is made, surgical decompression is indicated for both lesions. However, literature about the surgical approaches and prognosis of this disease is lacking.**

■ METHODS: **From March 2005 to April 2013, 30 patients with ct-TSS and a mean age of 49.8 years were recruited. We outlined 2 types of ct-TSS lesions—adjacent and skip lesions. The surgical approach for ct-TSS with adjacent lesions was combined cervical and thoracic decompression via a single posterior incision; the approach for skip lesions was 2-stage sequential cervical and thoracic decompressions. Neurologic status was evaluated with the Japanese Orthopaedic Association scale for cervical myelopathy.**

■ RESULTS: **Seventeen patients underwent 1-stage surgery, and 13 patients underwent the 2-stage procedure. After surgery, 27 patients (90%) experienced improvement. Main complications included transient neurologic deterioration in 7 patients, dural tears in 14 patients, and new radiculopathy in 4 patients. Combined and staged groups were comparable in terms of total length of decompression, occurrence of perioperative complications, and recovery rate ($P > 0.05$). The average Japanese Orthopaedic Association score increased significantly from 9.8 $\pm$ 1.9 to 13.7 $\pm$ 3.0 ($P < 0.05$), and the average recovery rate was 54.4%.**

■ CONCLUSIONS: **The types of stenotic lesions should be considered when planning surgery for patients with ct-TSS. One-stage decompression is suitable for patients with adjacent stenotic lesions; staged procedures should be considered for other patients.**

INTRODUCTION

Previous publications reported a rare yet challenging clinical entity, in which symptomatic cervical and thoracic tandem spinal stenosis (ct-TSS) simultaneously occurred.[1-4] Theoretically, 2 surgical options are available in this situation—1-stage combined decompression or 2-stage sequential decompressions of cervical and thoracic lesions. However, studies describing surgical techniques and outcomes of either surgical option are lacking. Chen et al.[1] reviewed 15 patients with ct-TSS who exclusively underwent 1-stage decompression and found that the clinical outcomes were comparable to outcomes after 2-stage surgeries. This finding is quite encouraging, considering the benefits of 1-stage decompression, such as a single hospitalization and anesthetic procedure. However, this surgical option is invasive and associated with more perioperative complications.[1]

The literature regarding surgical techniques and outcomes of 2-stage cervical and thoracic decompressions is scarce, so it is difficult to say whether 1-stage and 2-stage surgeries have comparable outcomes. Furthermore, alleviation of neurologic symptoms or, more specifically, elimination of compression remains the primary goal of the surgeries, so more work should be done to establish an optimal treatment algorithm for this entity. In

Key words
- Cervical spine
- Decompression
- Surgical outcome
- Tandem spinal stenosis
- Thoracic spine

Abbreviations and Acronyms
CD: Circumferential decompression
CSF: Cerebrospinal fluid
ct-TSS: Cervical and thoracic tandem spinal stenosis
JOA: Japanese Orthopaedic Association
LIF: Laminectomy with instrumented fixation
ODL: Open-door laminoplasty

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this study, we describe surgical techniques and outcomes of the 2 surgical strategies and discuss their applications in different stenotic lesions to provide more information on the treatment of this challenging entity.

MATERIALS AND METHODS

Patients

Consecutive patients with symptomatic ct-TSS who consecutively underwent surgery in our hospital were reviewed. Patients were included in the study if 1) they presented with symptoms or signs of neurologic deficits in both upper and lower extremities, 2) imaging work-up demonstrated spinal stenosis and abnormal signals within the spinal cord in cervical and thoracic spine, 3) the interval time for the 2-stage group was ≤12 months, and 4) regular follow-up for >2 years was available. This study was approved by the Institutional Review Board of Peking University Third Hospital, and written consent was obtained from all participants.

From March 2005 to April 2013, 30 patients were retrospectively recruited, including 11 men and 19 women. The mean age at surgery was 49.8 years. All patients presented with some extent of impaired walking ability; 23 patients complained of numbness or other sensory impairment in the trunk and/or lower extremities; and 8 patients had apparent numbness, stinging feeling, or hand clumsiness in the upper extremities. Urinary symptoms were experienced by 17 patients; 4 of these patients had urinary catheterization at admission. Physical examination demonstrated signs of neurologic deficits in both upper and lower extremities in all recruited patients. Imaging work-up showed multilevel cervical and thoracic compression in all patients. Pathologically, the diagnosis of 28 patients included, but was not limited to, ectopic ossification and encroachment of ligaments within the spinal canal—ossification of posterior longitudinal ligament and ossification of ligamentum flavum, also known as ossification of the yellow ligament. Specifically, 22 patients had ossification of posterior longitudinal ligament in both cervical and thoracic spines. The other 2 patients had a diagnosis of intervertebral disc herniation, osteophyte formation, or developmental spinal canal stenosis. We assigned patients to 2 different groups based on their stenotic lesions (Figure 1). If cervical and thoracic lesions were ≥3 vertebrae apart, patients were assigned to the skip group; otherwise, they were assigned to the adjacent group.

Surgical Procedures

Surgeries for all recruited patients were performed by the senior authors (X.L. and Z.L.). The procedure was conducted under general anesthesia and intraoperative electrophysiologic monitoring. Patients were positioned prone, supine, or lateral recumbent accordingly. The compressive levels were ascertained according to the patient's neurologic symptoms, physical examination, and imaging findings. Generally, the decompression range was in line with compressive lesions but occasionally included the level rostral and caudal to this range. Seventeen patients underwent 1-stage surgery, and 13 patients underwent 2-stage surgeries.

All patients in the 1-stage group presented with adjacent type of ct-TSS (Figure 2). Patients were positioned prone through the procedure. One single posterior midline incision was made.

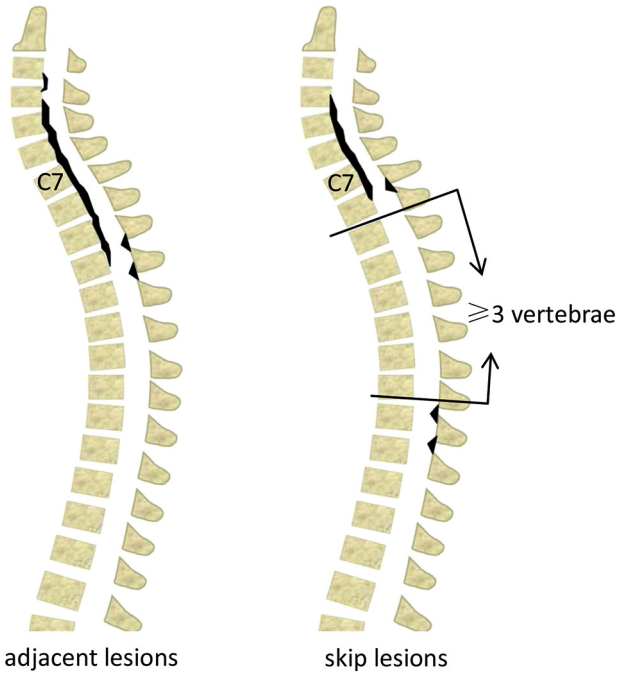

Figure 1. Representative drawings of different stenotic lesions in patients with cervical and thoracic tandem spinal stenosis.

Decompression for both cervical and thoracic lesions was accomplished via posterior approaches. Specifically, cervical decompression was accomplished via left open-door laminoplasty (ODL) in 15 patients and laminectomy with instrumented fixation (LIF) by lateral mass screws in 2 patients. Thoracic decompression was accomplished via laminectomy in 9 patients, LIF by pedicle screws in 4 patients, and LIF combined with circumferential decompression (CD) in 4 patients. The surgical techniques have been previously described in detail.[5,6]

Four patients in the 2-stage group presented with adjacent type of ct-TSS, whereas the other 9 patients presented with skip type (Figure 3). Cervical decompression was performed first via ODL in 9 patients, anterior corpectomy with instrumented fixation in 2 patients, ODL combined with anterior discetomy with instrumented fixation in 1 patient, and LIF in 1 patient. After 2–12 months (average 5.4 months), thoracic decompression was performed via LIF in 5 patients, LIF combined with CD in 7 patients, and anterolateral extrapleural decompression in 1 patient. Specifically, the patients were positioned prone in ODL, LIF, and LIF combined with CD procedures; supine in anterior corpectomy with instrumented fixation and anterior discetomy with instrumented fixation procedures; and lateral recumbent in the anterolateral decompression procedure.

The average length of decompression levels was 8.4 ± 1.7 vertebrae (Table 1). One-stage surgery mainly involved decompression of cervical and upper thoracic spines, whereas 2-stage surgeries involved cervical and the whole thoracic spinal segments (Figure 4). Intraoperative ultrasound, together with