2015

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Moon S. Park
Hallym University

Seong-Hwan Moon
Yonsei University

Hwan-Mo Lee
Yonsei University

Tae-Hwan Kim
Hallym University

Jae K. Oh
Hallym University

See next page for additional authors

Delayed Surgical Intervention in Central Cord Syndrome with Cervical Stenosis

Moon Soo Park[1] Seong-Hwan Moon[2] Hwan-Mo Lee[2] Tae-Hwan Kim[1] Jae Keun Oh[3] Bo-Kyung Suh[1] Seung Jin Lee[1] K. Daniel Riew[4]

[1] Department of Orthopaedic Surgery, Hallym University Sacred Heart Hospital, Medical College of Hallym University, Gyeonggi-do, Republic of Korea
[2] Department of Orthopaedic Surgery, Yonsei University College of Medicine, Seoul, Republic of Korea
[3] Department of Neurosurgery, Hallym University Sacred Heart Hospital, Medical College of Hallym University, Gyeonggi-do, Republic of Korea
[4] Department of Orthopedic Surgery, BJC Institute of Health at Washington University School of Medicine, St. Louis, Missouri, United States

Address for correspondence Dr. Moon Soo Park, MD, PhD, 896, Pyeongchon-dong, Dongan-gu, Anyang-si, Gyeonggi-do, 431-070, Republic of Korea (e-mail: amhangpark@gmail.com).

Global Spine J 2015;5:69–72.

Abstract

Study Design Review of the literature.

Objective It is generally accepted that surgical treatment is necessary for central cord syndrome (CCS) with an underlying cervical stenosis. However, the surgical timing for decompression is controversial in spondylotic cervical CCS. The purpose of this study is to review the results of early and delayed surgery in patients with spondylotic cervical CCS.

Methods MEDLINE was searched for English-language articles on CCS. There were 1,653 articles from 1940 to 2012 regarding CCS, 5 of which dealt with the timing of surgery for spondylotic cervical CCS.

Results All five reports regarding the surgical timing of spondylotic cervical CCS were retrospective. Motor improvement, functional independence measures, and walking ability showed similar improvement in early and late surgery groups in the studies with follow-up longer than 1 year. However, greater improvement was seen in the early surgery group in the studies with follow-up shorter than 1 year. The complication rates did not show a difference between the early and late surgery groups. However, there are controversies regarding the length of intensive care unit stay or hospital stay for the two groups.

Conclusions There was no difference in motor improvement, functional independence, walking ability, and complication rates between early and late surgery for spondylotic cervical CCS.

Keywords
- central cord syndrome
- cervical spine
- surgical timing

Introduction

Schneider et al originally described central cord syndrome (CCS) as "a syndrome of acute central cervical spinal cord injury characterized by disproportionately more impairment of the upper than in the lower extremities, bladder dysfunction, usually urinary retention, and varying degrees of sensory loss below the level of the lesion."[1] CCS is usually seen in elderly

received
August 12, 2014
accepted after revision
October 12, 2014
published online
November 6, 2014

DOI http://dx.doi.org/10.1055/s-0034-1395785.
ISSN 2192-5682.

patients with cervical stenosis or spondylosis with a hyperextension injury to the cervical spine.[1,2] In patients with cervical spondylotic CCS who are managed conservatively, the condition usually remains unchanged or improves, but older patients have a poorer prognosis for improvement of neurologic function.[3,4] Many reports suggest that surgery for cervical spondylotic CCS improves the rate and degree of neurologic recovery.[5–8] However, a controversy exists regarding the timing of surgery.[9] To our knowledge, no article has reviewed the surgical timing for these patients. The purpose of this work is to review the results of early and delayed surgery in patients with spondylotic cervical CCS.

Methods

The terms "central cord syndrome" and "cervical vertebrae" and "decompression, surgical" were used to search the MEDLINE database, which consists of literature published from January 1940 through December 2012. We included English language publications on CCS with spondylosis. The articles about CCS with acute disk herniation, fracture, and/or dislocation or ossification of posterior longitudinal ligament (OPLL) were excluded. However, the articles with a mixed study population with spondylosis and acute disk herniation, fracture, and/or dislocation or OPLL were included. Review articles were excluded. We reviewed all articles and categorized them as randomized clinical trial, nonrandomized prospective study, and retrospective study. Finally, to focus on the most recent evidence, we limited our review to those works published on or after 2002.

Results

We identified 1,653 articles regarding CCS, of which 152 articles were about cervical CCS and 7 dealt with the surgical timing of cervical spondylotic CCS. One article about the surgical timing of cervical spondylotic CCS was published in 1996 and so was excluded.[10] Another article about the surgical timing of cervical spondylotic CCS was excluded because the authors did not perform a comparative statistical analysis.[7] We found five retrospective studies that met the study criteria (►**Table 1**). No prospective randomized controlled clinical trials and no prospective nonrandomized studies met the study criteria.

Lenehan et al investigated the clinical outcomes following early or delayed surgery for CCS with underlying cervical spondylosis.[11] Seventy-three patients were enrolled and the mean age was 57 years. Patients were divided into two groups according to the timing of surgery: within 1 day of injury ($n = 17$) or after 1 day of injury ($n = 56$).[11] The American Spinal Injury Association (ASIA) motor score and functional independence measures were retrospectively evaluated at 1 year. The ASIA motor score and functional independence measures showed greater improvement in the early surgery group ($p = 0.0359$, $p = 0.0474$, respectively).[11] The authors did not provide specific information about Short Form-36 (SF 36) scores, bladder management status, and walking ability. At the hospital discharge, 63% of patients were unable to void

Table 1 Clinical studies examining the surgical timing in patients with cervical central cord syndrome

Source	No. of patients	Mean age at injury, y (range)	Disease entity	Early surgery (d)	Mean follow-up, mo (range)	Outcome measures
Lenehan et al[11]	73	57.7 (21.8–86.7)	Spondylosis (73)	<1	12	ASIA motor score, functional independence measure, SF 36, bladder management status, walking ability
Guest et al[12]	50	45 (14–77)	Spondylosis (24), acute disk herniation (16), fracture and/or dislocation (10)	<1	36 (13–48)	PSIMFS, length of ICU stay, length of hospital stay
Chen et al[13]	49	55.9 (22–76)	Spondylosis (27), acute disk herniation (13), fracture and/or dislocation (9)	<4	56 (25–84)	ASIA motor score, WISCI, SF 36, bladder management status, spasticity, neuropathic pain, satisfaction
Stevens et al[14]	67	34 (16–82)	Not specified	<1	32 (1–210)	Frankel grading, length of the ICU stay, length of hospital stay, complication rates
Yamazaki et al[15]	23	59.6 ± 11.9	Spondylosis (21), acute disk herniation (2)	<14	Mean 41.3 ± 25.9	JOA score

Abbreviations: ASIA, American Spinal Injury Association; ICU, intensive care unit; JOPA, Japanese Orthopaedic Association; PSIMFS, Post–Spinal Injury Motor Function Scale; SF 36, Short Form-36; WISCI, Walking Index for Spinal Cord Injury.

spontaneously.[11] By 12 months after surgery, this number had fallen to 26%.[11] At 12-month follow-up, 43% of patients were capable of independent ambulation without assistance.[11]

Guest et al investigated the clinical results after early or delayed surgery for CCS. Fifty patients were included in their study and the mean age was 45 years.[12] Twenty-four patients with a preexisting spondylosis developed CCS after a hyperextension injury.[12] CCS was due to a fracture or acute disk herniation in 26 patients.[12] The patients with cervical spondylotic CCS ($n = 24$) were divided into two groups according to surgical timing: the early group, which was treated with surgery within 1 day of the injury ($n = 6$), and the delayed group, which had surgery more than 1 day after injury ($n = 18$).[12] Post–Spinal Injury Motor Function Scale converted from ASIA motor score, length of stay in an intensive care unit (ICU), and length of hospital stay were compared retrospectively at 3 years after surgery. There was no difference in the improvement of ASIA motor scores between the two groups for the patients with cervical spondylotic CCS.[12] However, the patients with cervical CCS from a fracture or acute disk herniation ($n = 26$) had greater improvement of ASIA motor scores with early ($n = 10$) compared with delayed surgery ($n = 16$).[12] The early surgery group had shorter ICU and hospital stays than the delayed surgery group.[12]

Chen et al evaluated 49 patients with a mean age of 55.[13] Twenty-seven patients with preexisting spondylosis developed CCS. CCS was secondary to a fracture or acute disk herniation in 22 patients.[13] The patients were divided into two groups according to the surgical timing: within 4 days ($n = 21$) and 4 days or more after injury ($n = 28$).[13] The patients were followed for a mean of 56 months, and ASIA motor scores were evaluated, along with walking ability using the Walking Index for Spinal Cord Injury (WISCI).[13] There was no difference ASIA motor score and walking ability improvement between the groups.[13] Also, there was no difference in ASIA motor score improvements for the subgroup with spondylotic cervical CCS as well as the patients with cervical CCS from a fracture or acute disk herniation.[13] However, the authors did not compare SF 36 scores, bladder management status, spasticity, neuropathic pain, or satisfaction between the two groups.

Stevens et al reported on 67 patients with a mean age of 34.[14] They were divided into three groups: surgery within 24 hours of injury ($n = 16$), surgery 24 hours or more after injury ($n = 34$), and delayed surgery on a second hospital admission ($n = 17$).[14] The mean follow-up was 32 months.[14] The Frankel grade, length of ICU and hospital stays, and complication rates were compared.[14] The longest surgical delay on a second hospital admission was 209 days.[14] There was no difference in motor improvement using the Frankel grade among the three groups.[14] Also, there was no difference with regard to length of ICU or hospital stay.[14] The three groups showed no differences in the complication rates.[14]

Yamazaki et al reported on 23 patients with a mean age of 59.[15] Twenty-one patients with a preexisting spondylosis developed CCS after a hyperextension injury and two patients developed CCS from an acute cervical disk herniation.[15] The patients were divided into two groups: surgery within 2 weeks of the injury ($n = 13$) or later ($n = 10$).[15] The Japanese Orthopaedic Association (JOA) scores were evaluated retrospectively.[15] The early surgery group had better recovery of JOA scores.[15] The authors recommended timely surgery, preferably within 2 weeks of the injury, to achieve a better functional outcome in selected patients.[15]

Discussion

CCS is the most common form of an incomplete spinal cord injury and occurs most frequently in older patients with cervical spondylosis.[1,2] It has been demonstrated that surgery for cervical spondylotic CCS improves the neurologic recovery compared with nonoperative treatment.[5–8] A survey of 971 spine surgeons regarding the timing of decompressive surgery for spondylotic cervical CCS revealed a great variability in preference for the surgical timing, with 13.5% of surgeons answering that they would operate within 2 to 4 hours versus 16.0% who would operate at 6 weeks.[9] The controversy prompted this literature review.

Of the 1,653 articles listed in MEDLINE regarding CCS, only 7 dealt with the surgical timing for cervical spondylotic CCS. Of these, only 5 met our criteria for inclusion, and all were retrospective studies. There are no randomized controlled trials or prospective studies that could provide guidelines for treatment. Motor improvement using ASIA motor scores or Frankel grades was similar between the early and late surgery groups in the studies with follow-up longer than 1 year (13 to 210 months), even though the definition of early surgery in the studies was different (within 1 day in two studies to within 4 days in one study).[12–14] However, the motor improvement using ASIA motor scores or JOA scores was better in the patients who underwent early surgery in the studies with follow-up shorter than 1 year (41 days to 1 year).[11,15] Again, the definition of early surgery in these studies differed (within 1 day in one study and within 14 days in the other study).[11,15] Likewise, the studies with long-term follow-up found no effect of surgical timing on the functional independence measures or walking ability, whereas the studies with short-term follow-up noted better improvement in the early surgery groups. The walking ability was similar between the early and late surgery groups in a long-term follow-up study of 56 months.[13] However, the functional independence measures improved more in the early surgery group in a study with a follow-up of 1 year.[11] The complication rates also did not differ in a study with 32 months' follow-up and 67 patients.[14] There are controversies regarding the effect of surgical timing on the length of ICU or hospital stay. The length of the ICU and hospital stay was shorter in the early surgery group in a study with 50 patients.[12] However, there was no such difference in another study with 67 patients.[14]

As with any study, the present investigation has several limitations, including the fact that the studies we reviewed were all retrospective and none were level I studies. In addition, there are no data regarding the patients who were lost to follow-up or who died. Additionally, the outcome measures were not consistent among the available studies.

Finally, some important factors in the recovery after surgery were not reported in the articles reviewed. Some patients had preexisting features of cervical canal stenosis and myelopathy prior to sustaining an extension injury, but others did not. In addition, the variables in relation to age and comorbidities may also play a role. Despite these shortcomings, to our knowledge, this is the first review concerning the surgical timing of spondylotic cervical CCS.

In conclusion, our results suggest that there is an acute necessity for high-quality, prospective randomized studies regarding the timing of surgery for spondylotic cervical CCS. What little evidence exists is all retrospective. Based on those few studies, it appears that there was no difference between early and late surgery for motor improvement, functional independence, walking ability, and complication rates. However, there is insufficient evidence to make strong recommendations regarding the timing of surgery.

Disclosures
Moon Soo Park, none
Seong-Hwan Moon, none
Hwan-Mo Lee, none
Tae-Hwan Kim, none
Jae Keun Oh, none
Bo-Kyung Suh, none
Seung Jin Lee, none
K. Daniel Riew, Board membership, CSRS, KASS; Royalties: Biomet, Medtronic Sofamor Danek, Osprey; Stock/stock options: Amedica, Benvenue, Expanding Orthopedics, Nexgen Spine, Spinal Kinetics, Spineolgy, Vertiflex, PSD

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