Catastrophic Dropped Head Syndrome Requiring Multiple Reconstruction Surgeries after Cervical Laminoplasty

Seiichi Odate, Jitsuhiko Shikata and Tsunemitsu Soeda

Department of Orthopaedic Surgery, Gakkentoshi Hospital, Kyoto, Japan

Abstract:

Introduction: Dropped head syndrome (DHS) after cervical laminoplasty (LAMP) is a rare complication, and no etiologies or surgical strategies have been reported. We present a patient who developed catastrophic DHS after LAMP despite having preoperative cervical lordosis that is known to be suitable for LAMP. We describe a hypothesis concerning the possible mechanism responsible for the DHS and a surgical strategy for relieving it.

Case Report: A 76-year-old woman underwent LAMP for cervical spondylotic myelopathy. She achieved satisfactory improvement of neurological symptoms immediately after surgery. However, her neurological symptoms began to gradually deteriorate. She exhibited a dropped head and complained of difficulty maintaining horizontal gaze. Postoperative images showed a focal cervical kyphotic deformity causing anterior shift of the head, and recurrence of spinal cord compression was observed. She underwent additional surgeries for three times, but none of them restored her to baseline status. Retrospectively, the preoperative loading axis of the head existed anteriorly, and she also had a high T1 slope because of rigid thoracic kyphosis. Her preoperative hyper cervical lordosis was compensation for the global spinal malalignment. After LAMP, in accordance with decreases in her cervical lordosis, her head shifted anteriorly. The abnormal lever arm acting on the neck put further stress on the neck extensors, and the overstretched neck extensors possibly no longer generated enough power to raise the head. Uncompensated very high T1 slope because of marked thoracic kyphosis plus invasion of the posterior extensor mechanism by LAMP may have contributed to her catastrophic DHS development.

Conclusions: In the treatment of cervical myelopathy, posterior decompression alone should be applied carefully to elderly patients with cervical sagittal imbalance even if they have apparent cervical lordosis. Once DHS occurs because of cervical sagittal imbalance, normalization of global spinal balance through corrective osteotomy may be indispensable for a successful outcome.

Keywords:

cervical spine, dropped head syndrome, cervical laminoplasty, sagittal balance, alignment, complication

Spine Surg Relat Res 2018; 2(3): 243-247

dx.doi.org/10.22603/ssrr.2017-0084

Introduction

Dropped head syndrome (DHS) is defined as weakness of the neck extensor muscles causing a correctable, chin-on-chest deformity[1]. We report on a patient with cervical spondylotic myelopathy who developed DHS after cervical laminoplasty (LAMP). We attempted three surgeries to manage her DHS, but were unhappy with the course. We describe a hypothesis concerning the possible mechanism responsible for the DHS and a surgical strategy for relieving it. This study was approved by the Institutional Review Board of the authors' institute.

Case Report

A 76-year-old woman presented with a 5 month history of bilateral hand clumsiness and a spastic gait. Neurological examination revealed cervical myelopathy with positive Hoffman's sign, hyperactive reflexes, and a preoperative Japanese Orthopedic Association score for cervical myelopathy (C-JOA score) of 10 points (full score: 17 points). Magnetic resonance imaging showed multilevel spinal cord compression (Fig. 1A). In August 2013, LAMP was performed from C3 to C7 after determining that she had sufficient cervical lordosis. The paravertebral muscles were detached

Corresponding author: Seiichi Odate, odasei1101@gmail.com

Received: November 15, 2017, Accepted: December 21, 2017, Advance Publication: April 7, 2018

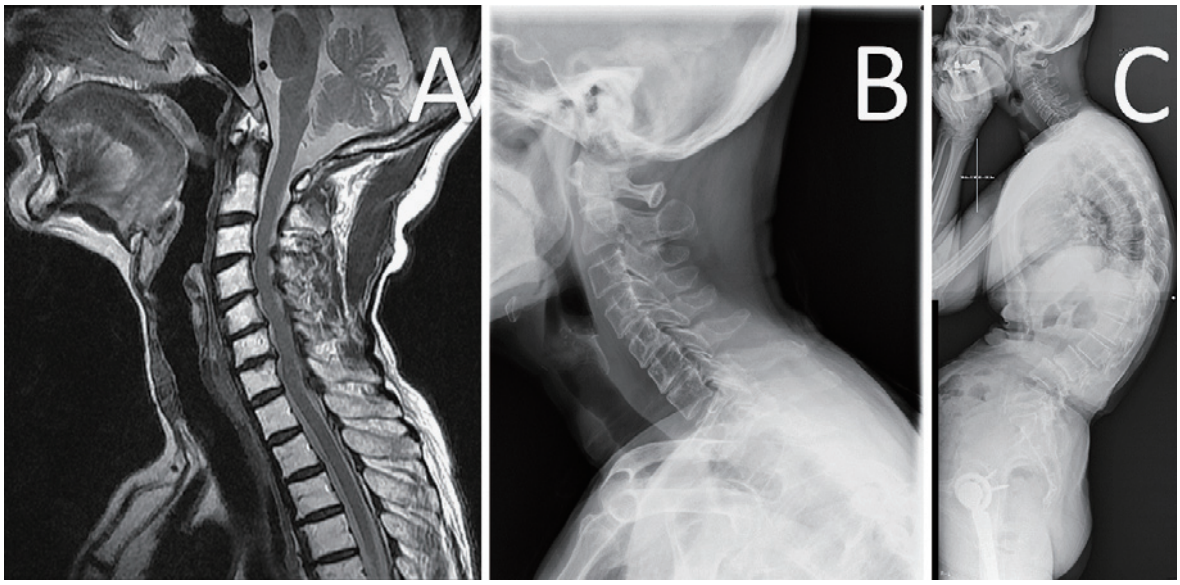

Figure 1. Preoperative images. (A) Sagittal T2-weighted MRI shows multilevel cervical cord compression. (B) X-ray shows cervical lordotic alignment (C2-7 angle, 30°), but the loading axis of the head is anterior (CGH-C7 SVA, 53 mm), which means that there was cervical sagittal imbalance. (C) Standing lateral X-ray shows marked thoracic kyphosis (Th5-Th12, 58°). As a compensation, there is hyperlordosis in the cervical and lumbar spine.

from the spinous processes on both sides, and the *semispinalis cervicalis* at the C2 spinous process was preserved. The laminae were split at the midline, and bilateral gutters were fashioned using a high-speed air-burr drill under microscopy. Hydroxyapatite spacers were placed between the split laminae and fixed with non-absorbable sutures to maintain an enlarged spinal canal (Fig. 1B). Postoperatively, she wore a Philadelphia collar for 2 weeks. Neurological symptoms improved satisfactorily immediately after surgery, and her C-JOA score improved to 15 points. However, her neurological symptoms began to gradually deteriorate, and her head had a tendency to drop. Neuromuscular disorders were excluded via neurological consultation. The 10 month postoperative images showed a focal cervical kyphotic deformity causing anterior shift of the head (Fig. 2A) and recurrence of spinal cord compression (Fig. 2B). As she refused to undergo additional surgery, she tried physiotherapy consisting of a strengthening program for the cervical and trunk extensor muscles, and she wore the Philadelphia collar again to correct the chin-on-chest deformity so as to enable a forward gaze. Nevertheless, the therapies were ineffective. Eighteen months after LAMP, her C-JOA score had decreased to 8 points, and she underwent a second operation, anterior cervical decompression and fusion (Fig. 3A). To maintain her head at an ideal position and to avoid reconstruction failure, halo-vest fixation was used for 8 weeks postoperatively. Nevertheless, cervical sagittal imbalance and dropped head were further progressed (Fig. 3B). Fifteen months after anterior fusion, she underwent a third operation, posterior fusion from C2 to Th5 (Fig. 4A). But the loading axis of the head still remained anterior to the sternum (Fig. 4B). Two months after the posterior fusion, reconstruction failure developed (Fig. 4C). In July 2016, she underwent a fourth operation, occipital-cervical-thoracic fusion (Fig. 4D), but this did not produce recovery of sagittal spinal balance to the normal range (center of gravity line from the head-C7 sagittal vertical axis (CGH-C7 SVA), 101 mm; C2-S1 SVA, 98 mm).

Discussion

Pathomechanism of DHS after LAMP

Although our patient exhibited pronounced cervical lordosis prior to the LAMP, kyphotic cervical alignment changes occurred after LAMP. Sakai et al. reported that preoperative cervical sagittal imbalance (CGH-C7 SVA ≧ 42 mm) and advanced age (≧75) were predictive factors of the post-LAMP kyphotic deformity[2]. Kim et al. reported that patients with high T1 slopes had more kyphotic cervical alignment changes after cervical LAMP[3]. Retrospectively, our patient had apparent cervical lordosis; however, the preoperative loading axis of the head existed anteriorly (CGH-C7 SVA, 53 mm), and she also had a high T1 slope (43°) because of thoracic kyphosis. According to both Sakai's and Kim's studies, our patient had characteristics compatible with a high risk for post-LAMP kyphotic alignment changes. Moreover, she developed not only cervical kyphotic alignment changes but also DHS after LAMP. To clarify the possible mechanism, it is important to consider not only her cervical alignment but also her global spinal sagittal balance in maintaining economic posture. In response to spinal malalignment, the human body begins recruiting compensatory mechanisms to maintain an erect posture, to maintain the head over the pelvis, and to retain horizontal gaze[4]. Thoracic kyphosis and global spinal alignment independently

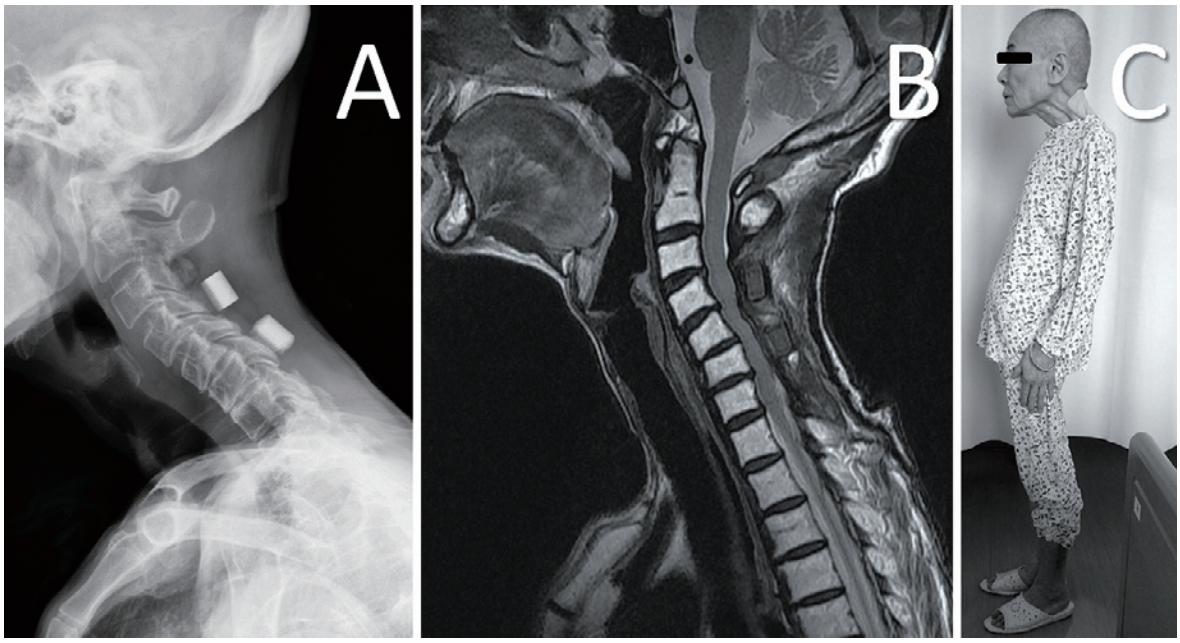

Figure 2. Images after first operation (cervical laminoplasty from C3 to C7). (A) X-ray at 10 months shows development of a cervical kyphotic alignment change combined with cervical disc degeneration. The loading axis of the head is shifted more anteriorly than shown preoperatively (CGH-C7 SVA, 75 mm). (B) Sagittal T2-weighted MRI shows recurrence of multilevel cervical cord compression despite the LAMP operation. (C) Photograph shows anterior shift of the head that demands sufficient power of the neck extensors to raise the head.

impact cervical alignment[5]. Patients with thoracolumbar malalignment exhibit increased cervical lordosis to compensate for balance adjustment and horizontal gaze[6]. Therefore, her preoperative cervical hyperlordosis might have been a compensation against rigid thoracic kyphosis to maintain horizontal gaze (Fig. 1C). However, the cervical lordosis was still an insufficient compensation because the preoperative loading axis of the head existed anteriorly. Under this situation, her posterior extensor mechanism was injured by LAMP, which resulted in the development of cervical kyphotic alignment changes. After LAMP, in accordance with decreases in her C2-7 angle (at 2 weeks, 30°; 1 month, 20°; 10 months, 9°; and at 16 months, 7°), her CGH-C7 SVA shifted anteriorly (at 2 weeks, 28 mm; 1 month, 49 mm; 10 months, 75 mm; and at 16 months, 88 mm). As the head shifts forward, greater stress is imposed on the neck extensors. But injured neck extensors no longer generated enough power to raise the head. These factors (uncompensated very high T1 slope because of marked thoracic kyphosis plus invasion of the posterior extensor mechanism by LAMP) may have contributed to her catastrophic DHS development.

Considering the results of previous studies and the findings of the present case, when treating cervical myelopathy, conventional LAMP should be applied carefully to elderly patients with cervical sagittal imbalance even if they have apparent cervical lordosis. Patients with sagittal malalignment tend to have increased cervical lordosis as a compensation. For such patients, deep extensor muscles play a critically important role in maintaining lordosis of the cervical spine. Minimally invasive posterior surgeries, such as muscle-preserving selective laminectomy may be better. Selective laminectomy preserves posterior structures, such as deep extensor muscles and facet joints, which preserve the inherent compensatory mechanism of cervical lordosis[7]. Alternatively, the anterior procedure is preferable because it does not impair the posterior extensor mechanisms and can thereby prevent postoperative kyphotic deformity[8].

Surgical strategy for DHS

Once DHS occurs because of cervical sagittal imbalance, it may gradually cause or aggravate preexisting degenerative changes in the cervical spine and ultimately result in myelopathy[9]. Conservative treatment is limited to strengthening exercises and wearing collars. The literature on surgical management of DHS is limited and mixed, with outcomes ranging from poor to excellent[9,10]. In our case, after DHS occurred, neither anterior cervical fusion nor posterior fusion stopped the progression of flexion deformity. Moreover, additional operations did not restore the loading axis of the head.

Bronson et al. succeeded in restoring horizontal gaze and improving sagittal malalignment for a DHS patient using a large correction composed of combined anterior soft tissue releases and posterior osteotomies[11]. Restoration of not only cervical but also global spinal balance through osteotomy for correction of kyphosis may be necessary for a successful outcome[12]. The goal of establishing global balance is to maintain the position of the head over the pelvis. Correction of thoracolumbar malalignment relieves the requirement for

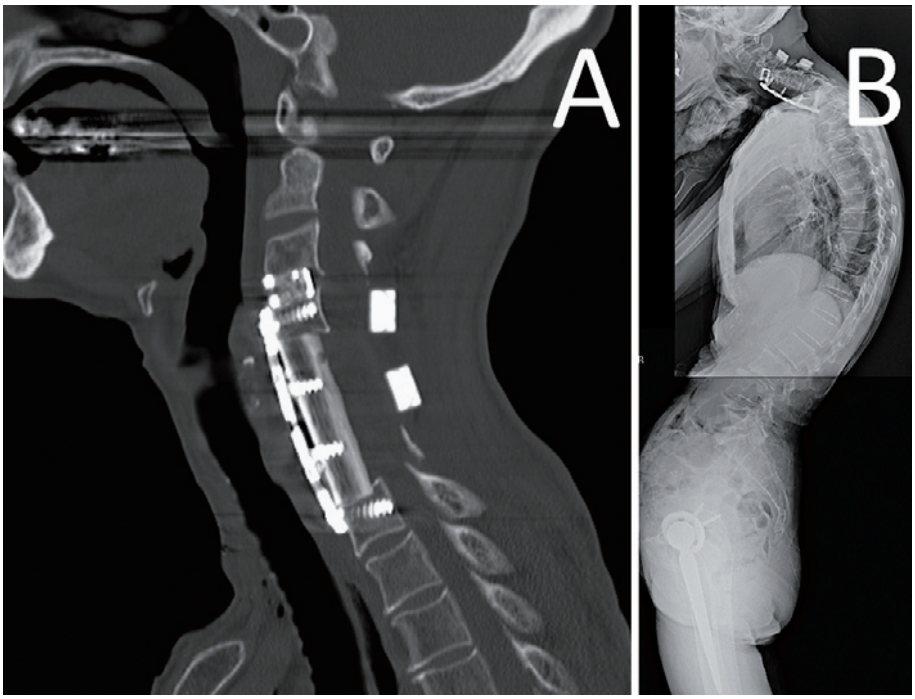

Figure 3. Images after second operation (anterior decompression and fusion from C3 to C7). (A) Sagittal reconstruction CT just after anterior fusion. (B) Standing lateral X-ray at 13 months shows recurrence of cervical kyphosis and dislodgement of the anterior plate.

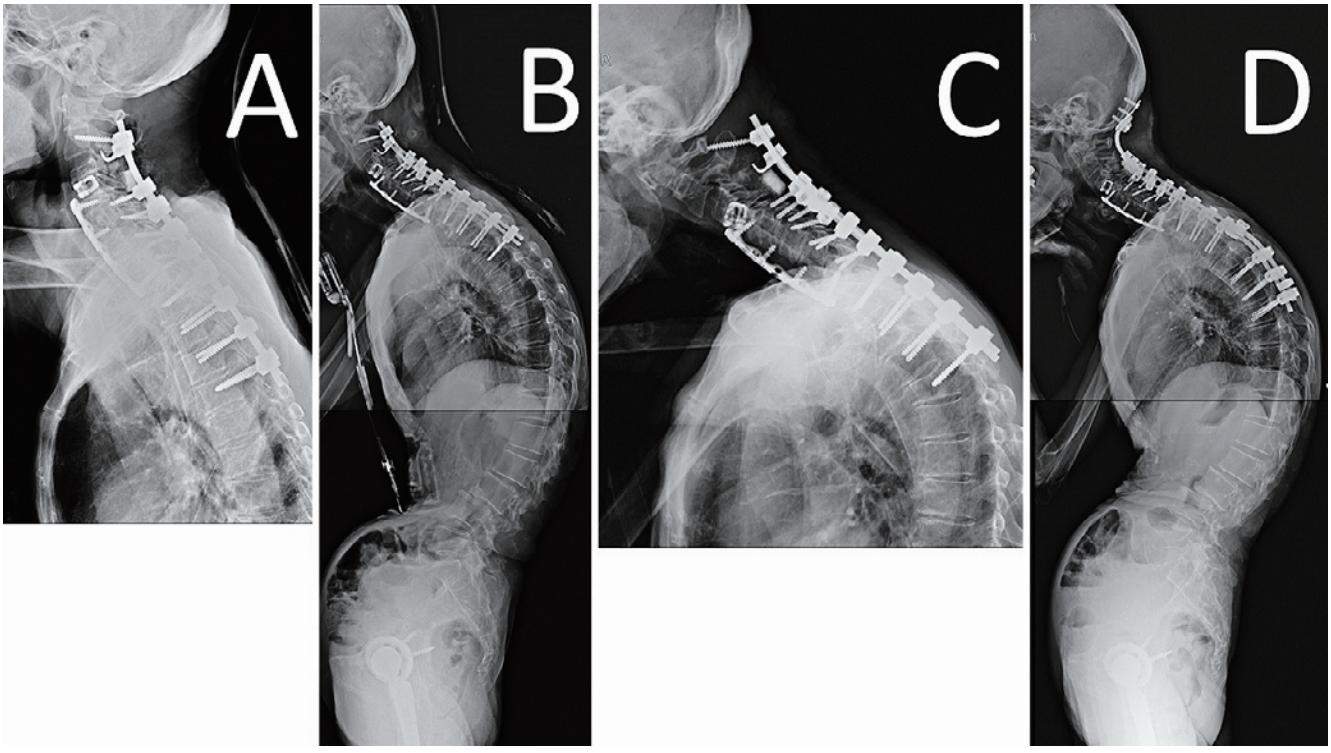

Figure 4. (A) Images after third operation (posterior fusion with C2 to Th5). X-ray just after posterior fusion. (B) Standing lateral X-ray at 1 month shows anterior shifting of loading axis of the head and deterioration of dropped head. (C) X-ray at 2 months shows multiple reconstruction failure (anterior cervical plate was dislodged, C2 pedicle screws were pulled out, and Th5 vertebra developed compression fracture). (D) Images after fourth operation (extension of posterior fusion with C0 to Th8). Standing lateral X-ray shows that the loading axis of the head still exists far anterior of the sternum (CGH-C7 SVA, 101 mm).

compensatory mechanisms, which result in reduced cervical lordosis[4].

Regarding the present case in the light of previous studies, in the state of uncompensated sagittal imbalance com-

bined with weakened neck extensor muscles after LAMP, normalization of the loading axis of the head via improving the high T1 slope by corrective osteotomy targeting the thoracic kyphosis may be reasonable to relieve continuous kyphotic forces on the neck extensor muscles. And it may be better to extend the construct to the lower thoracic spine in all patients who suffer from DHS with thoracic kyphosis. In conclusion, conventional LAMP should be applied carefully to elderly patients with cervical sagittal imbalance, even if the patients have apparent cervical lordosis. Once DHS occurs because of cervical sagittal imbalance, normalization of global spinal balance through corrective osteotomy may be indispensable for a successful outcome.

Conflicts of Interest: The authors declare that there are no conflicts of interest.

Acknowledgement: We wish to thank Dr. Takemoto M. for his invaluable wisdom and insight in assessing this case.

Author Contributions: Seiichi Odate wrote and prepared the manuscript, and all of the authors participated in the study design. All authors have read, reviewed, and approved the article.

References

1. Suarez GA, Kelly JJ, Jr. The dropped head syndrome. Neurology. 1992;42(8):1625-7.
2. Sakai K, Yoshii T, Hirai T, et al. Cervical Sagittal Imbalance is a Predictor of Kyphotic Deformity After Laminoplasty in Cervical Spondylotic Myelopathy Patients Without Preoperative Kyphotic Alignment. Spine (Phila Pa 1976). 2016;41(4):299-305.
3. Kim TH, Lee SY, Kim YC, et al. T1 slope as a predictor of kyphotic alignment change after laminoplasty in patients with cervical myelopathy. Spine (Phila Pa 1976). 2013;38(16):E992-7.
4. Day LM, Ramchandran S, Jalai CM, et al. Thoracolumbar Realignment Surgery Results in Simultaneous Reciprocal Changes in Lower Extremities and Cervical Spine. Spine (Phila Pa 1976). 2017;42(11):799-807.
5. Diebo BG, Challier V, Henry JK, et al. Predicting Cervical Alignment Required to Maintain Horizontal Gaze Based on Global Spinal Alignment. Spine (Phila Pa 1976). 2016;41(23):1795-800.
6. Ames CP, Blondel B, Scheer JK, et al. Cervical radiographical alignment: comprehensive assessment techniques and potential importance in cervical myelopathy. Spine (Phila Pa 1976). 2013;38 (22 Suppl 1):S149-60.
7. Nori S, Shiraishi T, Aoyama R, et al. Muscle-Preserving Selective Laminectomy Maintained the Compensatory Mechanism of Cervical Lordosis after Surgery. Spine (Phila Pa 1976). 2017.
8. Sakai K, Yoshii T, Hirai T, et al. Impact of the surgical treatment for degenerative cervical myelopathy on the preoperative cervical sagittal balance: a review of prospective comparative cohort between anterior decompression with fusion and laminoplasty. Eur Spine J. 2017;26(1):104-12.
9. Rahimizadeh A, Soufiani HF, Rahimizadeh S. Cervical Spondylotic Myelopathy Secondary to Dropped Head Syndrome: Report of a Case and Review of the Literature. Case Rep Orthop. 2016: 5247102.
10. Petheram TG, Hourigan PG, Emran IM, et al. Dropped head syndrome: a case series and literature review. Spine (Phila Pa 1976). 2008;33(1):47-51.
11. Bronson WH, Moses MJ, Protopsaltis TS. Correction of dropped head deformity through combined anterior and posterior osteotomies to restore horizontal gaze and improve sagittal alignment. Eur Spine J. 2017.
12. Caruso L, Barone G, Farneti A, et al. Pedicle subtraction osteotomy for the treatment of chin-on-chest deformity in a post-radiotherapy dropped head syndrome: a case report and review of literature. Eur Spine J. 2014;23(Suppl 6):634-43.