An Algorithmic Roadmap for Surgical Management of Degenerative Cervical Myelopathy: A Narrative Review

Dong-Ho Lee¹, Hyung Rae Lee², K. Daniel Riew³

¹Department of Orthopedic Surgery, Asan Medical Center, University of Ulsan College of Medicine, Seoul, Korea
²Department of Orthopedic Surgery, Uijeongbu Eulji Medical Center, Eulji University, Uijeongbu, Korea
³Department of Orthopedic Surgery, New York-Presbyterian Och Spine Hospital, Columbia University, New York, NY, USA

Degenerative cervical myelopathy (DCM) is a leading cause of disability, with its surgical management being crucial for patient neurological outcomes. Given the varied presentations and severities of DCM, treatment options are diverse. Surgeons often face challenges in selecting the most appropriate surgical approach, as there is no universally correct answer. This narrative review aims to aid the decision-making process in treating DCM by presenting a structured treatment algorithm. The authors categorized surgical scenarios based on an algorithm, outlining suitable treatment methods for each situation. Four primary scenarios were identified based on the number of levels requiring surgery and K-line status: (1) K-line (+) and ≤ 3 levels, (2) K-line (+) and ≥ 3 levels, (3) K-line (-) and ≤ 3 levels, and (4) K-line (-) and ≥ 3 levels. This categorization aids in determining the appropriateness of anterior or posterior approaches and the necessity for fusion, considering the surgical levels and K-line status. The complexity of surgical situations and the diversity of treatment methods for DCM can be effectively managed by utilizing an algorithmic approach. Furthermore, surgical techniques that minimize stages and address challenging conditions could potentially enhance outcomes in DCM treatment.

Keywords: Degenerative cervical myelopathy; Ossification of posterior longitudinal ligament; Treatment algorithm; K-line; anterior cervical diskectomy and fusion; Vertebral body sliding osteotomy; Laminectomy; Corpectomy

Introduction

Degenerative cervical myelopathy (DCM), a prevalent neurological disorder, exhibits varying prevalence and incidence due to the diverse classifications of degenerative processes and pathologies [1]. It is considered the most common cause of spinal cord dysfunction among the adult population, with a recent study estimating the incidence of related hospitalizations of 4.04 per 100,000 person-years [1,2]. The pathophysiology of DCM is multifactorial. DCM encompasses various degenerative conditions including spondylosis, degenerative disk disease (DDD), ossification of the ligamentum flavum (OLF), and ossification of the posterior longitudinal ligament (OPLL) [3]. Cervical spondylosis is an age-associated degeneration of the cervical spine due to excessive motion and repetitive trauma. Spondylosis begins with degenerative changes in the disk space and adjacent structures including facet
joints, uncovertebral joints, posterior longitudinal liga-
ment, and the ligamentum flavum [1]. Ossification of the
posterior longitudinal ligament (OPLL) also can cause
spinal cord compression, resulting in myelopathy. OPLL is
known to be more common in Asian populations. CT ex-
amination found that the prevalence of OPLL was as high
as 6.3% in the Japanese population, versus was 2.2% in the
non-Asian population [4.5]. Histologically, it is caused by
fibroblast and chondroblast proliferation, as well as intra-
membranous ossification [6].

The goals of surgical treatment include adequate de-
compression of the spinal cord, restoration of cervical
alignment, and fusion, if instability is present [7,8]. Vari-
ous surgical approaches have been developed and con-
troversy still exists regarding which operation should be
undertaken for different preoperative conditions. As such,
surgical planning tailored to each patient’s situation is now
becoming more important. This review article addresses
surgical strategies for cervical myelopathy in a narrative
fashion, based on existing preoperative evaluation systems
and techniques.

### Strategic Surgical Approaches in Degenerative Cervical Myelopathy: Evaluating Anterior, Posterior, and Combined Methods

For DCM, various surgical options exist, and the optimal
approach should be tailored to each patient’s specific char-
acteristics. Understanding the advantages and disadvan-
tages of each surgical technique is crucial for achieving the
best outcomes in DCM patients. The anterior approach
offers several benefits over the posterior approach: it allows
direct decompression of ventral pathologies (such as disk
disease, bony spurs, and OPLL), often results in minimal
neck pain, and aids in the restoration of cervical alignment
[9,10]. Spine surgeons typically prefer the anterior approach
for cases involving 1 to 2 levels, as complication rates tend
to increase in patients with disease at ≥ 3 levels [11-13].
Conversely, the posterior approach is suited for longer
level decompression. Its effectiveness hinges on the spinal
cord’s ability to shift posteriorly following decompression.
However, in cases of kyphosis greater than 10 to 13 degrees,
nervological recovery may not be as predictable, since a
posterior drift of the cord is less likely to occur [14,15].

The shape and size of the mass caused by OPLL or
spondylosis can also affect the outcome. The canal oc-
cupying ratio represents the proportion of the spinal
canal occupied by the mass [16]. Notably, when this ratio
exceeds 60%, the neurological outcomes following pos-
terior decompression tend to be less favorable compared
to those following anterior decompression [17]. This is
particularly the case when the mass protrudes sharply,
potentially diminishing the expected degree of neurologi-
cal recovery [17]. Therefore, two critical prerequisites for
effective posterior decompression would be a kyphosis of
less than 10° in cervical alignment and an adequate an-
teroposterior diameter of the spinal canal. Fujiyoshi et al.
[18] introduced the concept of K-line to consider both the
shape of the lesion and cervical alignment in patients with
DCM. Defined as a straight line connecting the midpoints
of the spinal canal at C2 and C7 on lateral cervical radiographs, the K-line helps in categorizing DCM patients
into two groups: those whose pathologies lie anterior to
the kyphosis line (K-line positive) and those that cross
posterior to the kyphosis line (K-line negative). The K-
line is frequently used by surgeons to determine the most
suitable surgical approach. Recently, various detailed pre-
operative evaluation modalities stemming from the K-line
such as the modified K-line [19] and kappa-line [20] have
been developed; however, there are many other parameters
to consider, in order to achieve the best results for any
individual patient, and it is often difficult to choose the
optimal treatment. Consequently, choosing between the
anterior versus posterior approach remains challenging,
especially when considering sagittal alignment, number of
levels involved, and lesion morphology and type. In cases
where rigid kyphosis and posterior pathologies coexist, a
combined anterior and posterior approach may be neces-
sary. A comprehensive understanding of the advantages
and disadvantages of each surgical approach is crucial for
achieving the best possible outcomes in DCM patients
(Fig. 1). To aid in this process, we propose some guide-
lines based on our experience, presented as a treatment al-
gorithm (Fig. 2). This approach aims to guide clinicians in
making informed decisions tailored to the unique needs
of each patient with DCM. Of course, surgeons should
choose the approach that they are most comfortable with
and that works best in their hands [21]. Prospective, mul-
ticenter studies have reported that neither the anterior
nor the posterior method can be declared definitively su-
perior, as there are many situations where each technique
may be advantageous [21,22]. We aim to outline the gen-
eral advantages and disadvantages of each approach, as
supported by current evidence, and offer possible options to serve as a guide for typical scenarios. Our goal is not to dictate a specific course of action, but rather to assist in informed decision-making that aligns with the best interests of each patient.

**Treatment Algorithms**

1. **K-line positive (compressive pathology lies ventral to the line) and ≤ 3 levels**

   Fig. 3 illustrates a case of cervical compressive myelopathy resulting from a disk protruding at C4-5 and migrating upwards either a C4-5 diskectomy or a C4 corpectomy is often selected for several reasons: (1) the pathology, located anterior to the cord, can be more readily accessed and removed via an anterior approach; (2) the anterior approach reduces the number of surgical levels involved. While the posterior approach would typically necessitate including at least the laminas of C3, C4, and C5, anterior decompression would involve only one or two levels; and (3) the loss of range of motion (ROM) through anterior fusion is generally insignificant within a two-segment operation, and the risk of nonunion is relatively low [23].

   ![](image1.png)

   **Fig. 1.** Surgical options for degenerative cervical myelopathy including the anterior approach and the posterior approach. DCM, degenerative cervical myelopathy; ACDF, anterior cervical diskectomy and fusion; VBSO, vertebral body sliding osteotomy.

   ![](image2.png)

   **Fig. 2.** Flow chart of the treatment algorithms for degenerative cervical myelopathy.
such, the anterior approach is better for lesions with ≤ 3 levels (Fig. 2).

The choice of treatment for cervical compressive myelopathy depends on the lesion’s location and shape, with various anterior approaches including Anterior Cervical Discectomy and Fusion (ACDF), corpectomy, and Vertebral Body Sliding Osteotomy (VBSO) being options (as illustrated in Fig. 1). However, these are not absolute indications. Even in cases involving fewer than two levels, posterior surgery may be appropriate, depending on the lesion’s location and the surgeon’s familiarity [24]. A recent meta-analysis has reported difficulty in determining the optimal surgical approach for treating multilevel DCM [25]. Generally, for diseases involving ≤3 levels, the posterior approach is less favorable compared to the anterior approach, especially when dealing with anterior spinal cord pathologies, due to the limitation in achieving indirect decompression [26]. ACDF is often considered the standard treatment for 1 to 2 level diseases [12,27-31]. Another alternative is corpectomy, which reduces the number of graft-host interfaces and allows for decompression behind the vertebral body [12,28,29,32,33]. However, corpectomy tends to present more perioperative challenges than ACDF. In a systematic review that included 1,372 patients, Han et al. found that ACDF yielded better outcomes than corpectomy in terms of complications and cervical sagittal alignment [34].

Addressing these concerns, we previously reported the use of a novel technique, VBSO, as an alternative to corpectomy for treating DCM [35]. VBSO involves anteriorly translating the vertebral body to expand the spinal canal, thereby reducing the need for direct removal of pathologies such as ossified masses and bony spurs [6,31,33,36]. Compared to corpectomy, VBSO has shown fewer complications, as it minimizes the direct detachment of the pathology from the dura [37]. In summary, the optimal strategy should involve weighing the advantages and disadvantages of different approaches to create a tailored plan for each patient.

2. K-line positive and >3 levels

In patients with K-line (+) status and lesions spanning >3 levels, the posterior approach may be preferable for most surgeons. This is due to the increased risk of complications associated with the anterior approach in such cases [19,25,26,38-40]. Anterior decompression, particularly in scenarios involving more than 3 levels, significantly raises the risk of complications such as dysphagia, pseudarthrosis, and graft failure [30,41-45]. Additionally, complications from corpectomy tend to be more severe, with increased risks of graft dislodgement and metal failure when two or more vertebral bodies are sacrificed [13,32]. Sasso et al. [12] reported a high graft failure rate and a substantial need for revision surgery following multi-level corpectomy. Therefore, when decompression of more than 3 levels is required, it is recommended to consider either a posterior decompression or a circumferential approach, rather than the anterior approach (Fig. 2).

Effective posterior decompression hinges on two critical conditions [46]. First, following the removal or expansion of the lamina, the spinal cord must have sufficient space to drift posteriorly. Second, it is essential to maintain a lordotic sagittal alignment; failure to do so can result in a bowstring effect on the cord due to kyphosis [47]. The surgical procedure should be extensive enough to include both the upper and lower levels of the pathology to facilitate this posterior drift of the cord. If this is not achieved, the cord may become trapped at the upper or lower level, leading to further neurologic compression. Studies examining the efficacy of posterior decompression in relation to the degree of kyphosis have shown that when kyphosis exceeds 10 to 13 degrees, neurological recovery is less likely due to inadequate posterior drift of the cord [14,15,48]. Uchida et al. [15] reported that patients with
DCM and either kyphosis or sigmoid alignment had better postoperative neurological outcomes with an anterior approach, as measured by the Japanese Orthopaedic Association (JOA) score. For patients with significant kyphosis, either an anterior approach or surgical correction of the kyphosis is recommended [31].

In cases with K-line (+) status and lesions involving > 3 levels, the posterior approach is generally recommended as the initial surgical option (as indicated in Fig. 2). Two surgical options are considered in this context: laminectomy with fusion and laminoplasty [19,20,49,50]. The key difference between these methods lies in whether fusion is performed. Studies have shown that the neurological outcomes of laminoplasty and laminectomy with fusion for myelopathy do not significantly differ [29,48,51,52]. Therefore, if a patient presents with confirmed neck pain and instability, laminectomy with fusion is advised. Conversely, in cases where neck pain is absent or mild, laminoplasty is the preferred option due to its decreased complication rates and cost-effectiveness—it is approximately 2.3 times less expensive than laminectomy with fusion [52-54]. This was demonstrated in a recent prospective, randomized, multi-center study by Ghogawala et al, comparing anterior vs posterior operations for myelopathy. All potentially randomizable cases were presented to study authors and the majority had to agree that either an anterior or posterior procedure was reasonable. Then the cases were randomized to either anterior or posterior surgery. If randomized to the anterior approach, the surgeon could choose either ACDF or corpectomy. If randomized to the posterior approach, the surgeon could choose either laminoplasty or laminectomy and fusion. Laminoplasty had the lowest complication rates of any procedure [55]. However, it is important to note that performing laminoplasty in patients who already suffer from axial neck pain or instability might exacerbate these conditions, potentially leading to worsened neck pain, progressive deformity, and neurological decline [56-58].

Another consideration in choosing a patient for posterior surgery has to do with their overall sagittal alignment. If laminoplasty is done in patients with an increased C2-7 sagittal vertical axis (SVA) greater than 35-40 mm, there is a higher probability of developing post-operative deformity and neck pain. In addition, a higher T1 slope (>20 degrees) increases the risk of post-operative kyphosis and may affect outcomes. Therefore, in such patients, alternative methods to correct the malalignment may be necessary [57,59-63].

3. K-line negative (compressive pathology extends posterior to the line)

The neurological results tend to be less favorable when posterior decompression is performed on K-line (-) patients [50]. While the outcomes may improve compared to the pre-surgical condition, there is an increased risk of various complications of laminoplasty, which would hinder the achievement of a full or satisfactory neurologic recovery [64]. Additionally, posterior decompression in K-line (-) patients is linked with a higher likelihood of transient C5 palsy, postoperative kyphotic deformity, worsening of neck pain, and progression of pathologies such as OPLL [65-68]. Therefore, alternative methods should be considered for K-line (-) patients. These include anterior decompression and posterior decompression, with a focus on changing the K-line status. Anterior decompression and fusion not only decompresses the spinal cord but also has the potential to alter the K-line from (-) to (+). This alteration is achieved through the restoration of cervical lordosis and removal of the pathology. If laminectomy and fusion is considered as the posterior approach, it is critical to restore the alignment such that all of the compressive pathology lies ventral to the K-line. Even with a total laminectomy, posterior drift of the cord is inadequate to achieve a full decompression if the compressive pathology lies dorsal to the K-line. Further details on this will be discussed below.

4. K-line negative and ≤ 3 levels

The anterior approach usually leads to better outcomes than posterior surgery in K-line (-) patients, as anterior surgery includes direct resection of the anterior pathology and restoration of the cervical alignment [29,39]. When the pathology is located behind the vertebral body, corpectomy is a conventional surgical method used in the anterior approach [28,69]. However, it’s important to note that corpectomy can be a technically challenging procedure for some surgeons and is associated with a higher incidence of surgery-related complications. Previous research has highlighted the elevated risk of intraoperative or post-operative implant dislodgement and dural tears during corpectomy [69-71]. Additionally, cerebrospinal fluid (CSF) leakage is a notable complication of
corpectomy, potentially leading to significant increases in operating time [39,70,72]. The floating island method for OPLL is considered when the probability of CSF leakage is high, especially when accompanied by a double-layer sign in CT images [67,73]. This technique involves thinning down the OPLL and leaving an island of ossified dura intact and letting it float away from the cord. While effective in decreasing the risk of dural tears, it does have drawbacks, such as potentially insufficient decompression versus dural violation [67].

VBSO allows for the expansion of the spinal canal by anteriorly translating the involved vertebral bodies (Fig. 4). Previous studies have demonstrated that VBSO offers advantages over corpectomy, notably in reducing the risks of dural tear and pseudarthrosis, while effectively decompressing the spinal cord [36,37,49,74]. In addition to providing adequate decompression, VBSO has shown superior results in restoring cervical lordosis and improving sagittal alignment (Fig. 5) [31,36]. It has also been observed to achieve faster union compared to ACDF [33,49]. Recent studies have indicated that VBSO exhibits a higher fusion rate across various parameters, such as interspinous motion, intragraft bone bridging, and extragraft bone bridging, and also shows a markedly lower subsidence rate compared to corpectomy [33]. The occurrence of pseudarthrosis and subsidence following anterior cervical surgery can lead to poor clinical outcomes, such as persistent neck pain and radiculopathy, and may necessitate revision surgery [65,75]. The rapid and robust fusion following VBSO is attributed to the ample exposure of bone marrow facilitated by the lateral troughs [33]. The multiple fixation points in VBSO, as opposed to the long strut single graft in corpectomy, create a shorter and more stable lever-arm effect [32,33]. This stability contributes to a lower rate of
subidence and reduced likelihood of kyphotic changes post-surgery [31,36,74,76]. The dramatic restoration of cervical lordosis after VBSO is further enhanced by the insertion of multiple lordotic cages. Therefore, VBSO is recommended as an alternative to corpectomy, particularly for patients with a high canal space-occupying ratio and K-line (-), owing to its effectiveness in reducing complications and enhancing surgical outcomes [31,36,74,76].

5. K-line (-) and > 3 levels

In cases involving > 3 levels (as shown in Fig. 2), posterior decompression is often preferred, due to the increased risk of complications like pseudarthrosis following extensive anterior surgery [25]. However, for K-line (-) cases, simply performing posterior decompression might not suffice for adequate neurologic recovery; thus, altering the K-line from (-) to (+) becomes essential. This can be achieved by restoring cervical lordosis, which facilitates a posterior drift of the spinal cord. The restoration of the lordotic curve alters the K-line status, as it represents a parameter that can be adjusted surgically [77]. If the kyphosis is flexible, the posterior-only approach can be used [24,31]. For assessing flexible kyphosis, obtaining a plain lateral flexion-extension dynamic radiograph is crucial. If the cervical alignment shows neutral to lordosis in the extension lateral radiograph, the patient may be categorized as having DCM with flexible kyphosis [78,79]. In such cases, posterior decompression through laminectomy and fusion, performed in the neck extension position, can be a viable and safe option. This approach not only ensures adequate decompression but also facilitates the alteration of the K-line [31]. Conversely, if the kyphosis is rigid, a posterior-only approach could exacerbate the kyphosis due to the disruption of the posterior tension band, increasing the risk of screw pull-out. In situations where rigid kyphosis persists and adequate lordosis is not achieved even in the neck extension position, surgical intervention to restore cervical lordosis becomes necessary for K-line alteration [31]. It is important to know that in lordosis, the foramen closes down further than when the cervical spine is in a neutral or kyphotic position. Therefore, if a patient has foraminal stenosis and the neck is placed into a lordotic position and rigidly fixed, iatrogenic root deficits may occur. This has been born out in numerous studies, where a laminectomy and fusion resulted in C5 and C8 palsies and recently verified in the Ghogawala study, which noted a 12% major and 3% minor motor root deficit following laminectomy and fusion.

To convert a K-line from negative to positive in cases of rigid kyphosis, the inclusion of an anterior approach is recommended. With an anterior first approach, one can decompress the foramina, restore the interpedicular height, as well as the lordosis. Then the posterior stabilization and fusion is done to maintain alignment and insure a high fusion rate. Others prefer to perform posterior decompression and screw fixation first, followed by anterior surgery to alter cervical alignment and then, they apply a posterior rod [80,81]. This sequence of procedures, known as the circumferential or combined approach (P-A-P surgery), is particularly relevant for patients with instability, severe osteoporosis, or a high risk of graft failure [81,82]. In an effort to streamline the circumferential approach, research has focused on making the three stages of P-A-P surgery more efficient. The use of VBSO has been instrumental in this regard, reducing the number of surgical stages [31,36,76]. For instance, Fig. 6 shows a patient with K-line (-) DCM and staircase deformity, who had severe osteoporosis (T-score: -3.6) due to prolonged steroid use.

Fig. 6. Preoperative and postoperative CT and MRI images for the 59-year-old woman in Figure 5 undergoing VBSO C3-6. (A) The K-line was negative preoperatively and positive postoperatively. (B) Adequate decompression was achieved after a single stage of VBSO.
for rheumatoid arthritis. Although the standard treatment in such cases of rigid kyphosis would typically be the circumferential P-A-P surgery [79], VBSO was employed instead. This approach successfully achieved both decompression of the spinal cord and alteration of the K-line. Considering the patient’s severe osteoporosis, posterior screw fixation without decompression was additionally performed on the same day. VBSO proved advantageous by accomplishing cervical alignment restoration and adequate decompression in just one stage of anterior surgery, without the common risks associated with corpectomy, like dural tear and CSF leakage (Fig. 7). Thus, in patients indicated for P-A-P surgeries, VBSO can reduce the surgical stages to a single session. This technique has gained recognition for its distinct advantages over traditional methods in treating patients with DCM [24,83].

A solution for addressing cervical myelopathy caused by continuous type OPLL has been previously proposed [84]. We have highlighted that K-line (-) DCM cases typically yield poor outcomes if treated solely with posterior decompressive surgery. In these situations, corpectomy is often considered, particularly when dealing with continuous or mixed-type OPLL located behind the vertebral body. To mitigate these risks, we introduced the greenstick fracture technique, aimed at reducing complication rates while restoring cervical lordosis [85]. This technique involves initial posterior decompression, followed by thinning of the OPLL mass using bur drilling after diskectomy. Instead of completely excising the OPLL mass, an incomplete fracture is created in the shallow mass, and a lordotic cage is inserted to restore cervical lordosis. This technique is illustrated in Fig. 8. The MRI sagittal view reveals severe cord compression, with a confirmed K-line negative status. A kyphotic alignment is also observed in the plain lateral radiograph (Fig. 8E). CT scans indicate the presence of continuous type OPLL (Fig. 8C), suggesting that this patient experiences cord compression across more than 3 levels and presents with rigid kyphosis, categorizing them as a K-line negative case. Consequently, both K-line alteration and decompression are essential requirements for the surgeon (as outlined in Fig. 2). In this scenario, posterior decompression with the laminoplasty technique (Fig. 8F) was initially selected. The presence of continuous type OPLL and involvement of more than three levels made decompression and K-line alteration through VBSO technically challenging [86]. Consequently, decompression was achieved through laminoplasty, followed by a three-level ACDF performed anteriorly. The greenstick fracture technique was applied to restore cervical lordosis, thus achieving a simpler two-stage P-A surgery instead of the more complex three-stage P-A-P procedure. Notably, the presence of continuous type OPLL in this patient provided an advantageous aspect regarding instability, allowing us to substitute posterior fusion with laminoplasty. Both VBSO and the greenstick fracture technique are centered on the concept of K-line alteration. However, VBSO offers the added benefit of facilitating canal expansion,
which eliminates the need for initial posterior decompression that might otherwise be necessary to prevent canal narrowing due to changes in lordotic alignment.

**Conclusions**

In conclusion, for cases of DCM where the disease level is ≤3, anterior decompression methods such as ACDF, corpectomy, and VBSO can be considered. For patients with a positive K-line and >3 levels of disease, laminoplasty is generally the preferred initial treatment option, particularly in the absence of neck pain and instability. In instances where fusion is necessary, posterior laminectomy and fusion is recommended.

In situations where dural adhesion is a concern, VBSO can serve as an effective alternative to corpectomy. The greenstick fracture technique is a useful approach for addressing cervical alignment changes in specific cases, such as long, continuous OPLL with a K-line (-) status. When dealing with >3 levels of disease, accompanied by flexible kyphosis, laminectomy with posterior instrumentation is recommended to facilitate the alteration of the K-line. Conversely, in the presence of rigid kyphosis with >3 levels of disease level, circumferential surgery can be utilized. VBSO can be a valuable technique for reducing the stages of surgery while minimizing complications such as dural tear, CSF leakage, pseudarthrosis, and subsidence.

Overall, employing an algorithmic approach in surgical scenarios can streamline complex decision-making and guide the selection of appropriate surgical methods. How-
ever, it’s important to note that our algorithmic approach is merely suggestive and should only serve as a reference tool. Because there are an infinite number of potential clinical scenerios, no simple algorithm can account for all the variations. In addition, different surgeons have different preferences, as well as skill sets that might favor a different approach than the one described. The described algorithm should therefore only be used to consider the advantages and disadvantages of each procedure, enabling surgeons to provide tailored treatments for individual patients. This approach emphasizes the importance of personalized care in achieving optimal outcomes in the treatment of DCM patients.

Conflict of Interest
No potential conflict of interest relevant to this article was reported.

References
60. Lee JS, Son DW, Lee SH, Kim DH, Lee SW, Song GS. The predictable factors of the postoperative kyphotic change of sagittal alignment of the cervical spine after the laminoplasty. J Korean Neurosurg Soc 2017;60:577-83.
62. Miyazaki M, Ishihara T, Notani N, Kanezaki S, Tsumura H. Relationship of T1 slope with loss of lordosis and surgical outcomes after laminoplasty for cervical
