Surgical Treatment of Postlaminectomy Cervical Kyphosis

Postlaminektomi Servikal Kifozun Cerrahi Tedavisi

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Abstract: Multilevel cervical laminectomy may cause cervical kyphosis in adults afflicted with preoperative instability or deformity in this part of the spine. The laminectomy procedure may also lead to cervical kyphosis in children who have no preoperative instability or deformity. This paper describes four cases of postlaminectomy cervical kyphosis that were surgically treated via an anterior approach with anterior decompression, fusion, and plating. Two of the patients were children when they underwent laminectomy. Three of the four patients showed clinical improvement. This report stresses the importance of considering posterior fusion when multilevel laminectomy is performed, in order to prevent cervical kyphosis. We recommend anterior decompression and fusion with plating as the best treatment for postlaminectomy cervical kyphosis.

Key Words: Anterior fusion, cervical laminectomy, cervical kyphosis, posterior fusion

Özet: Çok seviyeli servikal laminektomi preoperatif instabilitesi veya deformitesi olan erişkinlerde servikal kifoza neden olabilir. Ayrıca laminektomi işlemi preoperatif instabilitesi veya deformitesi olmayan çocuklarda da servikal kifoza yol açabilir. Bu çalışma postlaminektomi servikal kifozu olan ve anterior dekompresyon, füzyon ve plaklama ile tedavi edilen dört olguyu bildirmektedir. Olguların ikisi laminektomi uygulaması sırasında çocuk olan hastalardır. Dört hastanın üçü klinik düzelme göstermiştir. Bu çalışma, çok seviyeli laminektomi uygulandığında servikal kifozu önlemek için posterior füzyon düşünmenin önemini vurgulamaktadır. Bizler postlaminektomi servikal kifozun tedavisinde anterior dekompresyon, füzyon ve plaklamanın en iyi tedavi olduğunu vurguluyor ve bunun yapılmasını öneriyoruz.

Anahtar Kelimeler: Anterior füzyon, posterior füzyon, servikal laminektomi, servikal kifoz

INTRODUCTION

Cervical laminectomy provides optimal access for surgically treating many disorders of the cervical spine and spinal cord, including intradural and epidural tumors, trauma, syringomyelia, and cervical spondylotic myelopathy, among others. Adequate exposure of the laminae requires dissection of ligaments and muscles, which usually causes further instability in the region. As well, facetectomy is sometimes required, and this can also reduce stability. Interference with structures of the posterior spinal column (the laminae, facets, interspinous ligaments, ligamenta flava, and facet capsules) leads to cervical instability, and may result in cervical kyphosis. Children are more prone to instability due to their ongoing spinal growth and the laxity of their ligamentous structures. Bell et al. reported a 38% incidence of cervical kyphosis in children who had undergone cervical laminectomy (2). In adults with preoperative

cervical deformity or instability, laminectomy aggravates the problems that are already present (7,8).

Clinically, patients with cervical kyphosis tend to complain of neck pain or tetraparesis. Tetraparesis may result if the deformity significantly compresses the spinal cord. Patients usually have a history of having undergone surgery via a posterior approach to the cervical spine in the treatment of cervical spondylotic myelopathy, extramedullary tumor, syringomyelia, or Chiari deformity. Plain cervical x-rays reveal the kyphotic deformity, and magnetic resonance imaging (MRI) and computerized tomography (CT) scans allow more detailed assessment of the spinal canal and cord.

MATERIALS AND METHOD:

Clinical Information:

Four patients with postlaminectomy cervical kyphosis were admitted to our department between 1994 and 1996. All had undergone previous surgery involving a posterior approach to the cervical region. Two of the patients were children, one who had undergone laminectomy for cervical intradural tumor, and the other for an intramedullary tumor. At the time of their initial operation, these patients were 16 and 17 years of age, respectively. The latter had been diagnosed with neurofibromatosis type II with bilateral acoustic neurinomas, and the intramedullary tumor was found on a spinal scan. One of the adult patients had undergone surgery for cervical spondylotic myelopathy at our hospital in 1973. The other adult had undergone laminectomy for cervical trauma at another center, thus, we did not have the original surgical records and work-up for this case (Figure 3a).

Three of the patients complained of tetraparesis and spasticity that had developed and/or progressed over the years since their spinal procedure was done. One patient complained only of neck pain, and exhibited no neurological deficits. The time interval since the patients' initial surgery was 2 years and 8 months for the two adolescent cases (#1 and #2), respectively, and 23 years and 8 years for the two adult cases (#3 and #4), respectively.

Plain cervical x-rays for all four cases showed evidence of multilevel laminectomy and confirmed kyphotic angulation (Figures 1a,2a,3b). Table I shows the relationships between the angulation and the levels at which laminectomy was performed in each case. The patient who had had surgery for cervical spondylotic myelopathy exhibited atlantoaxial dislocation in addition to kyphosis.

The cervical CT scan of patient #3 demonstrated multiple laminectomies and showed proliferation of tissue at the site of laminectomy that had caused narrowing of the spinal canal.

Cervical MRI demonstrated kyphotic angulation causing ventral compression of the spinal cord in all patients (Figures 1b,2b,3c). The images showed atrophy of the cord and myelomalacia in the two patients who had tetraparesis and spasticity. MRI in patient #3 demonstrated atlantoaxial dislocation and pannus formation compressing the spinal cord at the tip of the dens. Table I summarizes the findings for all cases.

Surgical Technique:

We performed surgery on all four patients with an anterior approach to the cervical spine. Corpectomy and anterior decompression were carried out at all levels of the spine that showed severe vertebral angulation. Once the spinal cord was decompressed, we implanted a bone allograft. In all cases, the initial operation had compromised the integrity of the posterior spinal column, and we attempted to restore the lost stability using an anterior graft, and plating with 3.5 mm diameter cortical screws. In the patient with atlantoaxial dislocation, we initially performed dens resection via a transoral approach and occipitocervical posterior fusion in the same session. Two weeks after this operation, we performed an anterior approach to carry out corpectomy, anterior fusion, and plating.

RESULTS

We followed two of the patients for 2 years, and another individual for 1 year. The patient with atlantoaxial dislocation died of respiratory complications 20 days after the second surgery. Two of the tetraparetic patients improved significantly, and were eventually able to walk unassisted. The neck pain in patient #2 had resolved completely at 1 month postsurgery. Plain cervical x-rays taken 2 months after the operation showed that we had not achieved normal cervical alignment in patient #1, who had presented with severe kyphotic deformity (Figures 1c,d). However, we did achieve good spinal cord decompression and better cervical stability in this case, and the patient showed clinical improvement. In the other two patients (#2 and #4), we achieved almost-normal cervical alignment (Figures 2c,d,3d,e).

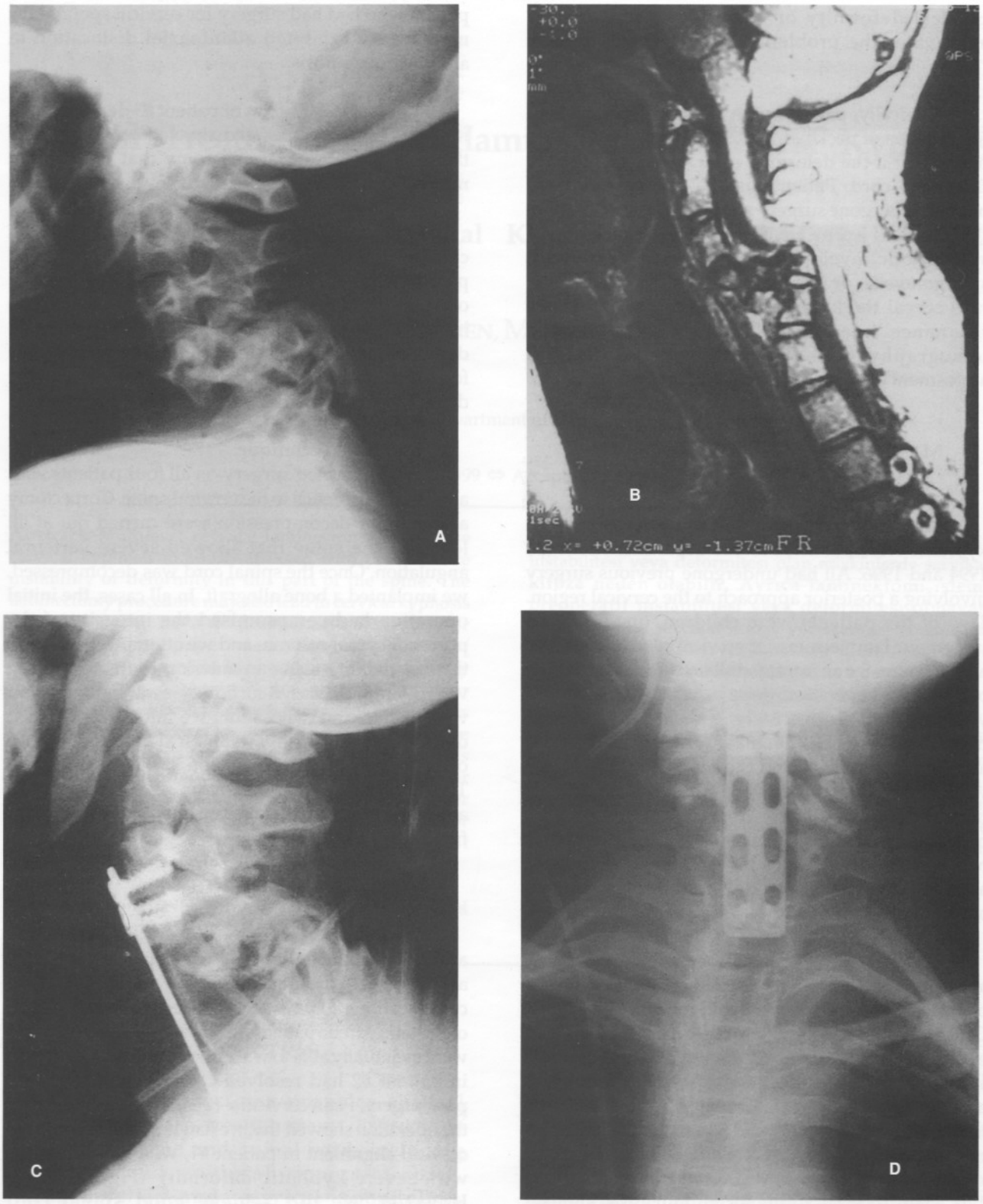


Figure 1: Patient #1 had a 115° cervical kyphotic deformity 2 years after he underwent multilevel laminectomy for resection of an intradural tumor. A lateral x-ray demonstrates severe angulation (a). Sagittal MRI shows severe anterior compression of the spinal cord (b). We achieved improved cervical stability through anterior allograft fusion and plating. Lateral (c) and anteroposterior (A-P) (d) x-rays show the postoperative results.

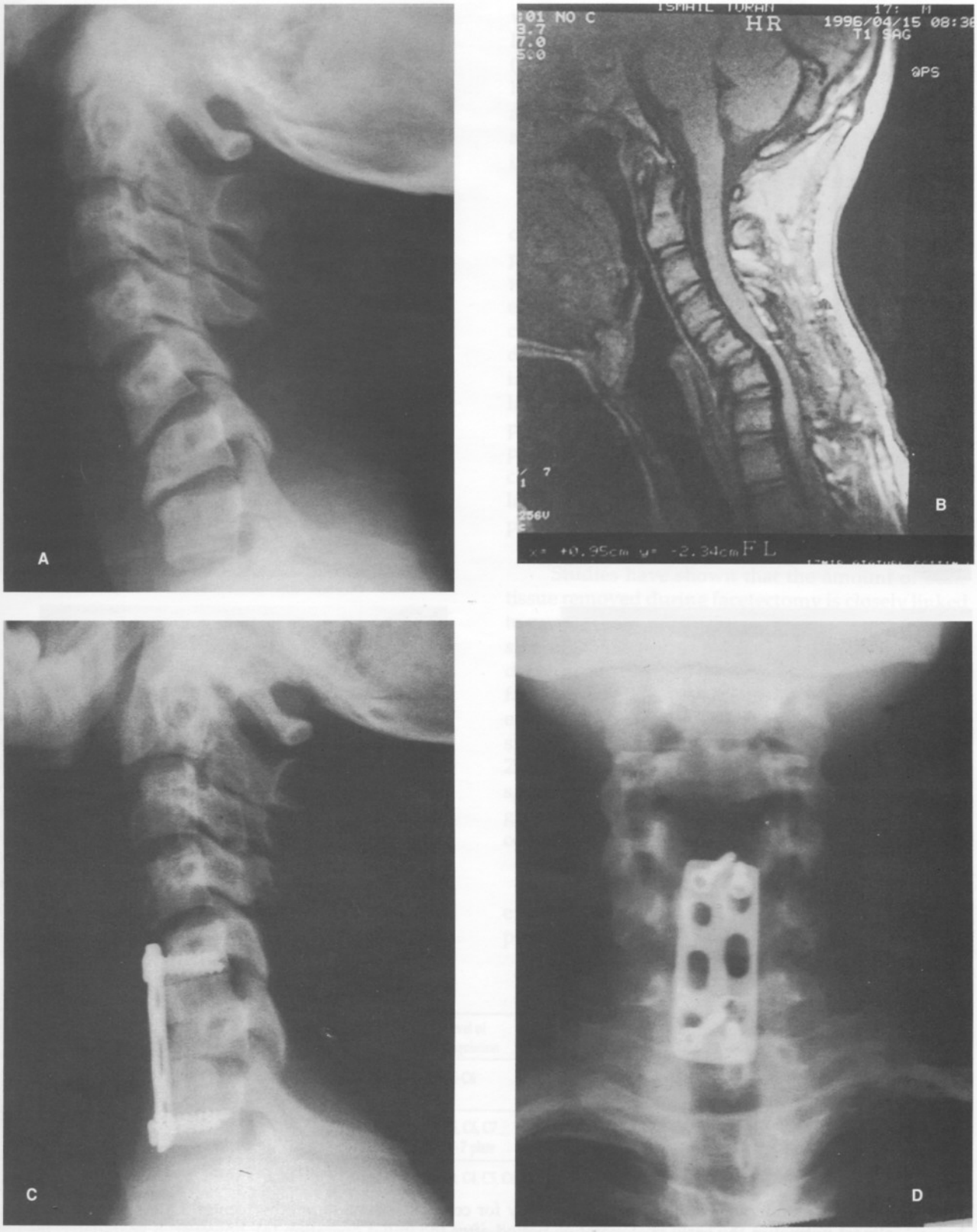
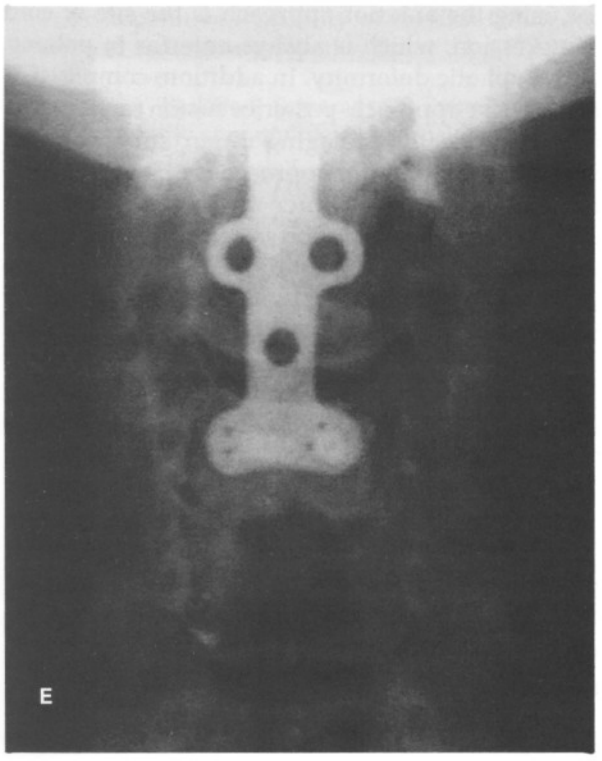


Figure 2: A 44° kyphotic deformity was detected at 8 months postlaminectomy (a). Sagittal MRI shows the spinal cord compressed at the level of angulation (b). Anterior decompression and plating restored the degree of angulation to almost normal, as seen on lateral (c) and A-P (d) x-rays.



DISCUSSION

The posterior approach to the cervical spine is used to address many pathological issues in this region. However, the procedure is not ideal in that it interferes with the integrity and strength of the posterior part of the spinal column, affecting the laminae, facet joints and capsules, spinous processes, ligamenta flava, and interspinous ligaments. Damaging these structures can weaken the posterior column and negatively impact cervical stability. Kyphotic deformity may be the end result months to years after posterior cervical surgery. In adults with preoperative deformity or instability, laminectomy will lead to more severe deformity (7,8). In our study group, patient #4 had undergone laminectomy after cervical trauma. The trauma had already compromised his cervical stability, and no attempt had been made to restore stability in his initial spinal surgery.

Any form of damage to the posterior spinal column almost always causes cervical instability, particularly in children, who are still growing and whose ligaments are more lax. Yasuoka et al. emphasized that cervical kyphosis can develop in children who have no preexisting deformity or facet damage (12). Two of the patients in this paper were in the pediatric age group at the time of their laminectomy surgery. These patients had no preexisting cervical deformity prior to their initial procedures. Raimondi and colleagues suggested that children should undergo laminotomy, not laminectomy, in order to prevent problems with postlaminectomy kyphosis (10).

Studies have shown that the amount of bone tissue removed during facetectomy is closely linked to cervical instability. Epstein emphasized that the size of facetectomy performed during foraminal decompression should not exceed one-third of the facet joint (4). Cusick and coworkers examined the effects of facetectomy and found a 53% reduction in spinal strength after bilateral total facetectomy (3). Zdeblick and Bohlman, in a study on human cadaver specimens, showed that facetectomy involving greater than 50% removal of the joint causes loss of cervical stability (14).

Most authors agree on a biomechanical explanation for the development of postlaminectomy kyphosis. According to this

Table I: Case summary

No #	Age *	Initial operation	Duration of kyphosis	Neurological symptoms	Level of angulation	Surgery	Preop angulation	Postop angulation	Follow-up period Neurological symptoms
1	17	Laminectomy for intradural tumor	2 years	Tetraparesis	C5-C6	Anterior fusion C3-7 plate	115 °	No change	2 years improved
2	16	Laminectomy for intramedullary ependymoma	8 months	Neck pain	C5, C6, C7 C5-7 plate	Anterior fusion	44 °	14 ° improved	2 years
3	43	Laminectomy for cervical myelopathy	23 years	Tetraparesis	C3, C4, C5, C6, C7	Anterior fusion C3-7 plate	32 °	No change	Died 20 days postsurgery due to respiratory complications
4	45	Laminectomy for cervical trauma	8 years	Tetraparesis	C2-C3	Anterior fusion C2-5 plate	40 °	10 °	1 year improved

* Age at first surgery

hypothesis, in the healthy body the nuchal ligaments, interspinous ligaments, and the ligamenta flava form a passive strain force that holds the neck in the neutral position. When these ligaments are destroyed at the time of laminectomy, the lack of tension from these supporting structures allows the head to tilt forward, shifting the loading axis on the neck forward. Ultimately, the neck remains flexed due to gravity.

Despite the theory that such forces are at work, postlaminectomy kyphosis is not common in adults. Segmental instability is a feature prior to laminectomy in patients with cervical spondylotic myelopathy, which makes these individuals susceptible to developing kyphotic deformity if the combination of posterior decompression and laminectomy is the chosen procedure. Patient #3 is an example of this situation. Miyazaki et al. have advocated posterolateral fusion for such cases, based on the disproportionately poor laminectomy results (9). Still, despite their use of posterolateral fusion, 50% of their patients developed a new deformity or their instability became worse postoperatively. Even though such results are disappointing, since posterior fusion is superior to anterior fusion, the former is still recommended as a means of avoiding postlaminectomy kyphosis in patients who undergo laminectomy.

The three approaches surgeons use to address postlaminectomy cervical kyphosis are posterior fusion and instrumentation (5), anterior corpectomy and instrumentation (6), and the combination of anterior corpectomy and posterior fusion (1). We used anterior corpectomy, grafting, and plating to achieve optimal cord decompression, since compression was an important issue in three of our four patients. Albert et al. have advocated that anterior corpectomy, fusion, and plating be followed by posterior fixation. They incorporated posterior fixation based on Zdeblick and Bohlman's observations that graft extrusion rates in postlaminectomy kyphosis patients were higher when anterior grafting and plating were done alone, as opposed to when posterior fusion was applied (14). However, Herman and Sonntag reported successful fusion in all patients with postlaminectomy cervical kyphosis, even after anterior fusion and plating (6).

We recommend anterior decompression and anterior fusion with plating when treating patients with postlaminectomy kyphosis. The main reason for using the anterior approach is the site of cord compression, which is always anterior in patients with kyphotic deformity. In addition, compared to the anterior approach, posterior fusion carries more risk of surgically damaging important structures. Surgically, the anterior approach is easier to execute than the posterior, since the patient has not undergone a previous procedure via this route. Posterolateral fusion cannot be performed on facet joints when these joints have already been partially removed during a patient's laminectomy surgery. Another advantage of anterior surgery is that the bone graft is under compressive but not tensile forces, a situation that promotes optimal fusion of the graft (5).

In conclusion, we advise that posterolateral fusion be done at the time of the laminectomy procedure to prevent postlaminectomy kyphosis. In cases where kyphotic deformity does develop, we recommend anterior decompression and fusion with plating.

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