CASE REPORT

Progressive Quadriplegia from Kyposis in Pediatric Patient after Laminectomy for Cervical Intramedullary Tumor Excision: Case Report and Literature Review in Short

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ABSTRACT

Cervical spinal deformities with progressive neurological deficit after laminectomy is relatively uncommon. But, it can happen more commonly after resection of intramedullary spinal cord lesions than other spinal lesion. Postlaminectomy cervical spinal deformity is most common in children with an immature skeletal system. Many factors such as the extent of laminectomy and facetectomy, number of laminae removed, location of laminectomy, preoperative loss of lordosis, postoperative radiation therapy, etc. can precipitate such deformities. We report a pediatric patient with who underwent successful complete removal of long segment cervical intramedullary spinal tumor. Postoperatively he developed progressive kyphosis in cervical spine with progressive neurological deficit. We went for second operation (anterior cervical spinal cord decompression by two segments corpectomy followed by iliac crest strut graft fusion and stabilization). Postoperatively patient recovered well. He had loss of cervical spinal lordosis with mild kyphosis before first operation. Such a case report in the literature is relatively uncommon. Here, we also go for short review of literature on this topic.

Keywords: Cervical spinal deformity, Neurological deterioration, Post laminectomy, Intramedullary spinal tumor, Pediatric patient.

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INTRODUCTION

Postlaminectomy cervical spinal deformities including swan-neck deformity and kyphosis can happen rarely after cervical laminectomy (which is a common surgical procedure in cervical spine). It is generally accepted that adults with normal preoperative spine alignment and stability rarely experience kyphotic deformity after cervical laminectomy.[1-3]

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In a pediatric patient with long segment cervical intramedullary spinal tumor with preoperative loss of lordosis, has increase risk to progress kyphosis and neurodeterioration after tumor excision through a long cervical laminectomy.[2] Here, we report such a case with short review of literature. We went for anterior cervical spinal cord decompression by two segments corpectomy followed by iliac crest strut graft fusion and stabilization. Postoperatively, patient recovered well. Such a case report in the literature is relatively uncommon.

CASE REPORT

A 17-year right-handed boy presented with progressive weakness in right upper limb for last 3 years, weakness and spasticity in rest of the limbs for last 1 year. He had no history of headache, neck ache or swallowing difficulty. His cranial nerves functions were normal. Neck and cervical spinal examination revealed no abnormality. Respiration was normal in rate and rhythm. His right upper limb was flail. There was atrophy of shoulder, arm, forearm and hand muscles. Muscle power was MRC grade—0/5 in all muscles of right upper limb except hand muscles where it was MRC grade—3^+/5. Muscle power in rest of the limbs was MRC grade—3/5(patient could walk with support). Hoffman sign was bilaterally positive. Planter response was bilaterally extensor. Deep tendon reflexes (DTRs) were exaggerated in all limbs except right upper limb where DTRs were absent. Sensations were diminished up to C2 dermatome. His bladder and bowel functions were normal. Other systems had no abnormality. X-ray cervical spine showed loss of cervical spinal lordosis with mild kyphosis involving mid portion of cervical spine. MRI showed contrast enhancing large intradural intramedullary spinal tumor involving C2-C7 (Figs 1A and B). His tumor was removed completely through laminectomy from C2-C7 taking care not to damage facet joints. Immediate postoperatively he needed ventilatory support and tracheostomy. His right sided motor function deteriorated further (right upper limb hand muscle 0/5 and right lower limb 2/5) and left-sided function remained static. By the end of second week, he came out from ventilator

and neurological functions began to improve in the limbs. By the end of 2 months, he could walk without support and right-sided hand movement returned but power was MRC grade $2^-/5$ and rest of the muscles in right upper limbs was 0/5. Histopathology reported grade 1 ependymoma. He was symptom free for another 3 months (5 months after operation). Then he developed neck pain and weakness in limbs with spasticity. This time his weakness rapidly progressed and became bed ridden. X-ray cervical spine showed moderate to severe kyphosis in cervical spine. Contrast MRI showed no residual or recurred tumor but there was severe compression of pencil shaped spinal cord by severe kyphosis of cervical spine involving C3, C4, C5 and C6 (Figs 2A and B). Reoperation was done through anterior approach. Cervical spinal cord decompression was done by C4 and C5 corpectomy with adjacent discectomy followed by fusion and stabilization (fusion was done with a large strut bone graft from iliac crest and stabilization was done by plate and screw). Postoperatively patient rapidly relieved from neck pain and limb neurological status began to improve. By the end of 4 months after second operation, he could walk without support and returned to his home activities though he had only hand movements (MRC grade 2/5) in right upper limb. By the end of 12 months after second operation, his right hand muscle power improved to MRC grade $3^+/5$ with return of flexion of right elbow (MRC grade 3/5). X-ray showed fusion. There was no further spinal deformity in subsequent follow-up X-rays (Figs 3A and B).

DISCUSSION

With the normal lordotic curve of the cervical spine, the weight-bearing axis lies posterior to the vertebral bodies. As a result, approximately two-third of the load is carried by the posterior columns.[4] Due to loss of the posterior ligamentous and bone elements after cervical laminectomy, the weight-bearing axis can shift anteriorly. This results in loss of lordosis and a change to a straight or kyphotic alignment, which moves the weight-bearing axis ventrally to a position in front of the vertebral bodies. As this kyphotic deformity progresses, the anterior column tends to be compressed and the posterior columns are placed under tension. The trauma of surgery weakens the posterior tension band, decreasing its ability to withstand the forces needed to maintain alignment. As a result, the kyphotic deformity propagates further stress and the deformity progresses.[2,5]

Many factors may precipitate postlaminectomy cervical spine deformity, i.e. age (pediatric),[6,7] extent of laminectomy and facetectomy,[5] number of laminae removed,[7,8] location of laminectomy (upper, middle or lower cervical spine),[9] preoperative loss of lordosis,[10] pathological condition in the spinal cord,[6,10,11] and radiation treatment in the spine.[2,6] Pediatric patients with an immature skeletal system has significant risk for deformity.[2,7]

Children who undergo multilevel laminectomies for intraspinal tumors (intra and extramedullary) have a high incidence of spinal column deformity, with reported rates between 24 and 100%.[6,12-15] The intraspinal lesions may be a confounding factor; intraspinal tumors are often associated with spinal deformities, even without surgery.[6] The cause of the increased incidence of spinal deformity after laminectomy in children is likely multifactorial. Ligamentous structures in the pediatric spine are more lax than those in adults. In addition, the orientation of the facet complex of the cervical spine is more horizontal in children than the vertically oriented facet complex seen in adults. The combination of these two factors allows for less stability and, with the right set of circumstances (such as loss of the posterior tension band after laminectomy), sagittal plane deformities can occur more easily. The growing vertebral column is another compounding factor; once deformities start, they tend to progress in the presence of a growing spine because of abnormal growth in association with the changes in spinal
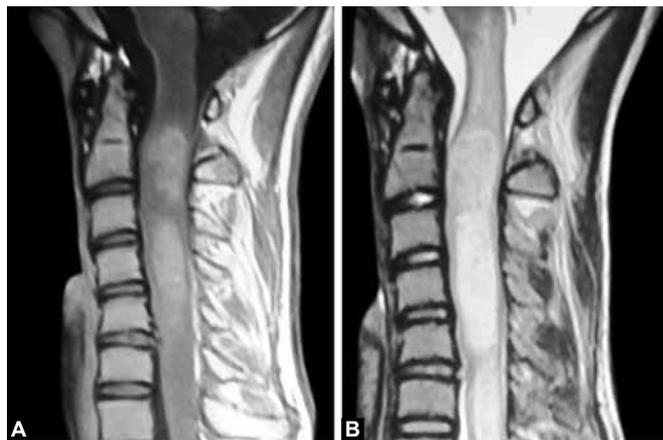
Figs 1A and B: Preoperative MRI of cervical spine sagittal sections: (A) T1-weighted and (B) T2-weighted images showing intramedullary tumor

Figs 2A and B: MRI of cervical spine 6 months after first operation sagittal sections: (A) T2-weighted and (B) T1-weighted images showing severe spinal cord compression with kyphosis
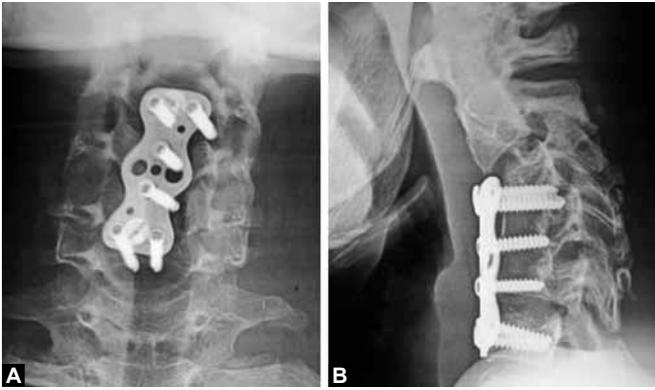
Figs 3A and B: Plain X-ray cervical spine A/P: (A) Lateral view and (B) after second operation

biomechanics. In the circumstance of an immature spine with growth plates, treatment with spinal radiation can also compound the deformity by creating asymmetrical growth patterns.[2,12,13] Spinal cord lesions alone, without surgery or surgical destabilization, can cause spinal deformities in both adults and children.[2,6] Involvement of the anterior horn cells causes muscle denervation and weakness, which leads to the spinal deformity.[16] A flexed posture, in cases of intradural lesions, tends to open the spinal canal and may relieve symptoms; however, this may lead a kyphotic deformity. The risk of postoperative deformities is double with preoperative spinal deformity.[10] The above-mentioned causes might caused preoperative loss of cervical spinal deformity in our case.

Laminectomy at high-stress areas like the craniocervical and cervicothoracic junctions is associated with a higher risk for postoperative spinal deformities.[8,9] The length (number of laminae removed) and extent (degree of facet resection) of laminectomy have both been reported to increase the risk of postoperative deformities.[2] Higher rates of instability occurs when the facet joints are destroyed by tumor or surgery.[8] Postradiotherapy spinal deformity can occur in children and adults. The affects of radiation appear to be more on the immature spine because of the asymmetrical growth patterns that result from therapy.[7,14,17,18]

The risk of postlaminectomy kyphosis should always be considered before approaching tumors in the spinal canal for resection, especially in higher-risk patients, such as children and young adults. Efforts should be made to limit facet resection (<50%) and the number of laminae removed without compromising the surgical exposure needed for tumor resection.[2] In pediatric patients, in whom the skeletal system is not mature, one can use laminoplasty in the hope of reducing the risk of postlaminectomy deformities. In the rare case of a patient with preoperative kyphosis, the surgeon should consider performing a stabilization procedure at the time of initial laminectomy for tumor resection.[2] No standard guidelines have been developed for this practice

of prophylactic fusion to prevent progression of deformity. Here we found preoperative loss of lordosis with mild kyphosis, but we were conservative and we went only for tumor resection and follow-up.

In postlaminectomy deformities, close observation with serial neuro-images is essential, as in a significant percentage of these conditions will continue to progress where surgical stabilization is needed. In the vast majority of cases, the deformity is a sagittal imbalance with either focal kyphosis or a more complex swan-neck type, which can be treated with anterior or posterior stabilization procedures.[12,19] Fixed deformities that do not move because of ankylosis will require a surgical release at the ankylosed segment before correction, and this may dictate the approach taken.[20]

For cases of focal kyphosis, anterior cervical discectomy and fusion with plate placement can be adequate. A better anatomical correction, with restoration of lordosis, can be made via an anterior approach than posterior procedures. Front-back combined stabilization procedures may be used for severe cases of kyphosis. Swan-neck deformities are much more complex in terms of surgical stabilization. An anterior procedure alone, with either multilevel discectomy and fusion or corpectomy with strut grafts, can accomplish reduction of alignment and stabilization. Restoring the sagittal balance with an anterior procedure alone, however, can be technically challenging.[2] In our case, kyphosis was involving four segments with severe spinal cord compression without any residual or recurrent tumor. So, we went for anterior decompression by corpectomy and fusion with stabilization.

Another option to treat swan-neck deformity is a front-back-front procedure, wherein the initial anterior multilevel discectomies or corpectomies are performed to release the anterior elements.[19] The anterior wound is then closed and the patient is repositioned prone. With the anterior elements released, a reduction in the sagittal alignment with restoration of lordosis can be accomplished with the patient prone. Placement of posterior instrumentation can also be used to help restore sagittal alignment and stabilize the spine. After the posterior surgical wound is closed, the patient is returned to the supine position and the anterior surgical wound is reopened. Bone grafting is performed to restore the integrity of the anterior column and optimize the likelihood of fusion. Anterior plate placement is optional with a front-back-front approach, but is preferred as it provides additional stabilization.[2]

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