



One-Stage Wedge Osteotomy Through Posterolateral Approach for Cervical Postlaminectomy Kyphosis with Anterior Fusion

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■ **OBJECTIVE:** Osteotomy through anterior exposure is challenging with severe complications for upper cervical kyphosis (CK), especially for cases with previous anterior fusion. A novel technique comprising 1-stage osteotomy via a posterolateral-only approach is introduced for treatment of CK secondary to C2-4 laminectomy for neurofibroma removal and subsequent anterior fusion.

■ **METHODS:** A 42-year-old man presented with progressive numbness and weakness of upper and lower limbs. As an adolescent, he underwent posterior laminectomy and neurofibroma excision without effective fixation and anterior C2-4 vertebra fusion 6 years later. Sagittal computed tomography indicated that Cobb angle between C2 and C6 was 68° with complete fusion between C2 and C4 vertebral bodies. Secondary CK was diagnosed based on medical history and radiographic findings, and modified Japanese Orthopaedic Association scale score was 10. Piezosurgery was used for osteotomy by shortening the vertebral height through posterolateral approach after cervical pedicle screw placement. Occipitocervical fusion was performed with compression between C2 and C4.

■ **RESULTS:** Cobb angle was adjusted to 8° postoperatively. Modified Japanese Orthopaedic Association score increased to 14 with obvious muscle strength improvement. The 6-month postoperative x-ray indicated good position of C2-4 vertebrae and occipitocervical fixation system. No neurologic complications or local recurrence was found at final follow-up at 8 months. The patient returned to work in his full capacity.

■ **CONCLUSIONS:** Preliminary outcomes reveal wedge osteotomy via piezosurgery through a posterolateral-only approach is feasible and effective in revision surgery for upper CK with previous anterior fusion.

INTRODUCTION

Cervical kyphosis (CK) is a progressive and challenging spinal deformity that can be congenital or caused by various acquired factors (e.g., degenerative, neoplastic, or infectious disease). Surgery is the most common iatrogenic cause of CK, and postlaminectomy kyphosis (PLK) often requires corrective surgery after several years, especially for adolescents.¹⁻⁵ The optimal surgical approach for CK remains controversial; a combined anterior and posterior approach is usually recommended for revision surgery for PLK owing to the required wide-spectrum correction.^{1,6,7} However, the exposure through an anterior approach can be difficult in certain circumstances (e.g., upper cervical spine, previous fusion surgery, or radiation history). Whether a transoral or submandibular approach is used, there is risk of severe neurovascular complications and hardware failure.^{8,9} In this article, we present a surgical technique comprising wedge osteotomy using piezosurgery through a posterolateral-only approach to manage upper PLK with previous anterior C2-4 fusion after initial neurofibroma removal.

MATERIALS AND METHODS

Case Illustration

A 42-year-old man presented to our department with progressive numbness and weakness of upper and lower extremities. He underwent C2-4 postlaminectomy and

Key words

- Anterior fusion
- Cervical spine
- Posterolateral-only approach
- Postlaminectomy kyphosis
- Wedge osteotomy

Abbreviations and Acronyms

- CK:** Cervical kyphosis
CT: Computed tomography
mJOA: Modified Japanese Orthopaedic Association
PLK: Postlaminectomy kyphosis
VA: Vertebral artery

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excision of intraspinal neurofibroma 32 years ago and anterior C2-4 vertebral fusion owing to spinal instability 26 years ago. Physical examination revealed obvious amyotrophy of the right upper limb and grade 3 muscle strength in left lower limbs. Hyperreflexia was detected on both knee and tendon reflexes, with positive bilateral Hoffmann and Babinski signs. Lateral x-ray showed the C2-7 sagittal vertical axis was 40 mm. Sagittal computed tomography (CT) showed severe kyphosis with Cobb angle of 68° between C2 and C6, and the C2-4 vertebral bodies were completely fused. Magnetic resonance imaging showed severe spinal cord compression at C2-3 and C3-4 levels, and no tumor recurrence was found on contrast-enhanced magnetic resonance imaging (Figure 1). Score on the modified Japanese Orthopaedic Association (mJOA) scale was 10.¹⁰ In addition, the patient's neck was relatively short with a large mandible.

Surgical Technique

Considering the high risk and sacrifice of an anterior approach, after comprehensive discussion with the patient's family it was decided to perform a posterolateral wedge osteotomy. CT angiography was performed to evaluate the bilateral vertebral arteries (VAs). The process of osteotomy was conducted via computer preoperatively for better correction surgery. Somatosensory evoked potentials were used to monitor the neurophysiologic function and cerebral blood supply throughout the procedure. After regular exposure between the occiput and C6 level, posterior pedicle screw instrumentation (Vertex Select Reconstruction System; Medtronic, Minneapolis, Minnesota, USA) was placed from C2 to C5. The Vertex Select Reconstruction System

occipitocervical module was set at the proper position of the occiput in advance. The bilateral posterior arches of the atlas were carefully isolated (the VA was first exposed and identified at the sulcus arteriosus of C1) and removed by piezosurgery (also known as ultrasonic bone scalpel) (Figure 2).

The left titanium rod was attached to the screws transiently for right-side osteotomy, then the bone mass between C2 and C4, which was previously used as the fusion osseous material after the first laminectomy, was totally resected via piezosurgery. The C3 lateral mass superior and inferior articular process was removed adjacent to the medial surface of the transverse foramen using a high-speed drill. Bilateral VAs at C2-4 level were identified by preoperative CT angiography and protected by intraoperative separation. Then the bilateral C3 nerve root was gently separated and ligated (at middle level of C3 vertebrae) for achieving a better working space subsequently. Blunt dissection of the dura mater was gently performed ventrally away from the posterior vertebral body wall. After using a sponge and bipolar coagulator for epidural venous plexus homeostasis, wedge osteotomy was performed bilaterally through a posterolateral approach with piezosurgery at C2-3 and C3-4 levels. The proximal end of the scalpel is an alternative with various tip options and can be adapted to different situations to manage various deformities. When the scalpel reached the other side, a pituitary rongeur and curettes were used to remove the vertebral body. One third inferior C2 vertebral body and one half inferior C3 vertebral body were removed in a wedge shape. After confirming no residual osseous granulation in the canal, the titanium rod (3.5-mm diameter) with proper curvature was attached to the screws (Figure 3). Then compression was

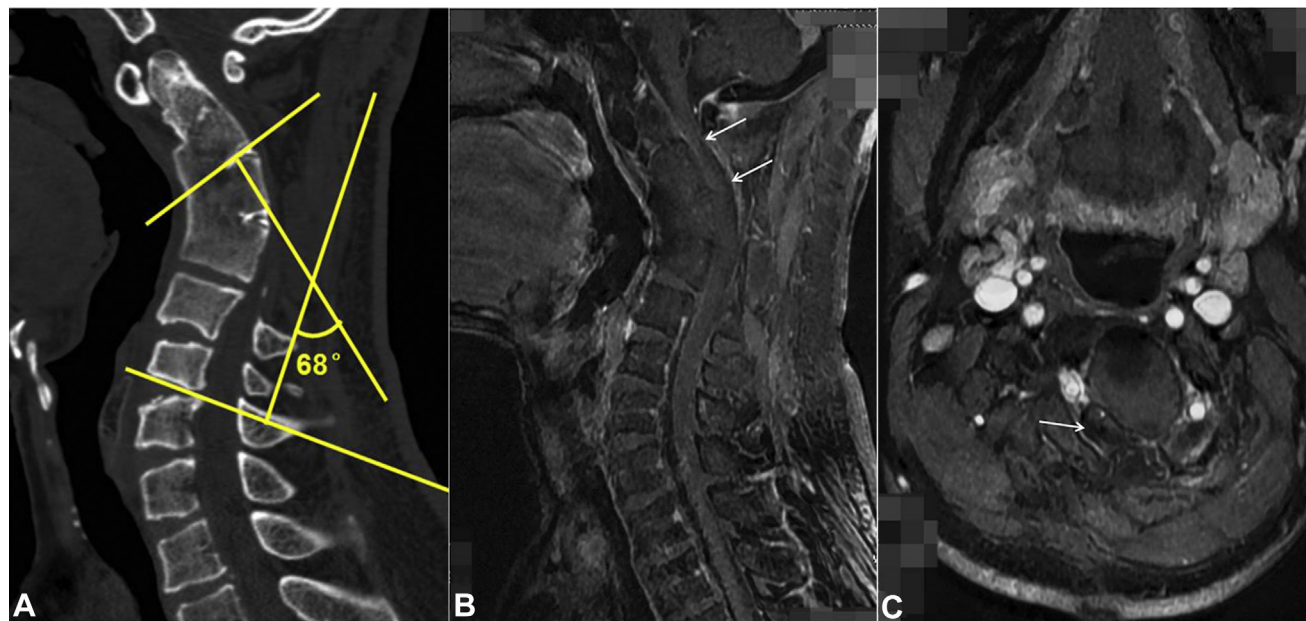


Figure 1. Preoperative computed tomography and magnetic resonance imaging. (A) Sagittal computed tomography image showing Cobb angle between C2 and C6 was 68°. (B and C) Magnetic resonance imaging showing severe spinal cord compression on C1-2 and C2-3 levels (arrows).

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