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Research Article

Less Invasive Surgery for Cervical Spine - A Technique of Anterior Oblique Keyhole Approach

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Abstract

Introduction: Anterior fixation using the iliac crest graft or a cage is the standard technique for accessing anterior cervical spine. However, it limits cervical motion and puts strain on adjacent discs, potentially leading to new lesions. The primary aim of anterior oblique keyhole approach is to treat anterior spinal cord disorders directly without requiring fusion manipulation. This approach can also be used for multilevel lesions. In this study, we report the advantages and effectiveness of this approach in 10 cases.

Methods: A total of 10 cases were included in the study, 7 males and 3 females, with mean age of 57.1 years. All cases had anterior spinal cord lesions: two with herniated discs, seven with cervical spondylosis, and one with ossification of the posterior longitudinal ligament (OPLL). Treated intervertebral levels involved one disc in one case, two discs in seven cases, and 3 discs in two cases. Pre- and postoperative neurological symptoms were assessed by neurosurgical cervical spine scale (NCSS). The operation was performed by creating a groove with an air drill from the anterolateral aspect of the vertebral body, followed by drilling deep into the vertebral body to directly reach directly the lesion. By extracting it, the spinal cord was decompressed. Lastly, the skin is sutured to end the surgery,

Results: The average operative time was 91 minutes, with minimal blood loss. After surgery, all patients showed improvement in symptoms immediately, and no complications were observed. This approach did not require fusion manipulation and did not cause postoperative limitation of cervical motion. Moreover, no postoperative cervical deformity was observed.

Conclusion: The approach was minimally invasive and did cause impairment or complications due to strain on adjacent intervertebral discs, making it suitable for elderly patients who aim to improve their quality of life. However, long-term follow-up is necessary, and further studies should be conducted to carefully evaluate other possible factors.

Keywords: Anterior Oblique Keyhole Approach; Antero-Lateral Partial Vertebrectomy; Spinal Lesions; Cervical Fusion; Spine Decompression

Abbreviations

APLV: Antero-Lateral Partial Vertebrectomy; OPLL: Ossification of the Posterior Longitudinal Ligament; NCSS: Neurosurgical Cervical Spine Scale; CT: Computer Tomography; MRI: Magnetic Resonance Imaging

Introduction

Anterior fixation using the iliac crest graft or a cage is the standard technique for accessing anterior cervical spine [1]. However, it is sometimes problematic because of postoperative limitation of cervical spine motion and effects on adjacent vertebrae, resulting in new anterior lesions of the spinal cord [2-4]. After anterior cervical fusion, the adjacent intervertebral space may become overloaded, resulting in osteophyte formation and intervertebral space narrowing.

The anterior oblique keyhole approach is a surgical technique similar to antero-lateral partial vertebrectomy (ALPV) [5]. Unlike the conventional posterior approach [6], ALPV directly removes and decompresses anterior spinal lesions such as cervical spondylolisthesis, cervical disc herniation, and ossification of the posterior longitudinal ligament (OPLL), and does not require bone grafting or fixation. Other surgical techniques such as trans-unco-discal approach [7], the multi-oblique corpectomies without fusion [8], and the microsurgical anterior foraminotomy [9] also appear to employ similar principles. In this study, we report a new technique in reaching and removing an anterior cervical spinal lesion, along with its advantages and effectiveness.

Materials and Methods

Cohort description

Ten cases recorded in [year], including seven males and three females, were included in this study. The patients' ages ranged from 44 to 72 years, with a mean age of 57.1 years. All lesions were anterior spinal cord lesions: two herniated discs, seven cervical spondylolistheses, and 1 OPLL. All patients presented sensory impairment. Nine patients demonstrated motor impairment. Six patients presented with only nerve root symptoms, while four also exhibited myelopathy.

Evaluation of neurological symptoms

Pre and postoperative neurological symptoms were assessed by neurosurgical cervical spine scale (NCSS) [10]. Improvement rate was classified as excellent (≥80%), good (60–79%), fair (40–59%), and poor (<40%).

Surgical technique description

A 5-cm transverse incision was made on the right anterior neck along the anterior margin of the sternocleidomastoid muscle to access the anterior surface of the vertebral body, following the conventional anterior cervical fixation approach. The right cervical longissimus muscle was dissected laterally until the transverse process was exposed. Under an operating microscope, an air drill was used from the anterolateral aspect of the vertebral body to create a 6-7 mm entrance groove, followed by drilling continuously through the vertebral body. The posterior longitudinal ligament was reached by deepening the entrance groove in a trumpet-shaped manner using the drill. The anterior aspect of the posterior longitudinal ligament was widened until 8-13 mm of its surface was exposed. The posterior longitudinal ligament was detached from the dura and removed with a Kerrison punch. After confirming that the spinal dura mater was bulging and pulsating well, the skin was sutured, marking the completion of surgery. The following day, a soft cervical collar was placed on the patient that did not restrict activities of daily living. Two weeks after the surgery, the collar was no longer required. The indications for this procedure were (1) absence of cervical instability; (2) anterior spinal cord lesions, including herniated disc, cervical spondylosis, and ossification of posterior longitudinal ligament; and (3) lesions between the C3/4 and C7/Th1 levels.

Results

Surgical outcomes

Minimal bleeding was observed in all cases. The operation time ranged from 70 to 120 minutes, with an average of 91 minutes. The number of discs treated was as follows: two cases involving one intervertebral disc, six cases involving two intervertebral discs, and two cases involving three intervertebral discs. At specific intervertebral levels, C3/4 was performed in one case (5%), C4/5 in

five cases (25%), C5/6 level in nine cases (45%), and C6/7 in five cases (25%), with the C5/6 level being the most frequent treated level. The NCSS assessment indicated neurological improvements from the early stage. The mean postoperative score was 13.4, compared with a preoperative score range of 8-12 and a mean score of 9.6. A month after surgery, average improvement rate was 86.4%. Nine cases (90%) were assessed as excellent, while one was good (10%). No cases of cervical instability were identified on postoperative radiographs, and no obvious complications were observed.

Representative case

The patient was a 72-year-old man who had experienced numbness on the radial side of his bilateral upper extremities for a year. The numbness gradually worsened, and he noticed a decreased grip strength in both upper limbs, that led to his visit to our department. At presentation, right and left grip strengths were 12 kg and 15 kg, respectively. In addition, bilateral lower limb reflexes were hyperactive. Cervical MRI (Figure 1A, B) and CT scan (Figure 1C) confirmed anterior compression of the spinal cord due to OPLL at the C4/5 level. The preoperative NCSS score was 10. There were no special notes in the medical history of the case. Direct removal of the OPLL was performed using present technique. After the removal of the OPLL, the spinal cord was decompressed and observed to be bulging and pulsating well (Figure 2). Bleeding was minimal and the operation time was 80 minutes without recorded surgical complications. Immediately after surgery, numbness and dyskinesia alleviated. Patient's grip strength reached 30 and 32 kg on the right and left hands, respectively. The postoperative NCSS score improved to 13 and the improvement rate was excellent (insert rate here). The patient discharged seven days after surgery. Postoperative CT of the cervical (Figure 3A) spine showed complete removal of the OPLL, and cervical spine MRI (Figure 3A, B) showed adequate spinal cord decompression at the C4/5 level.

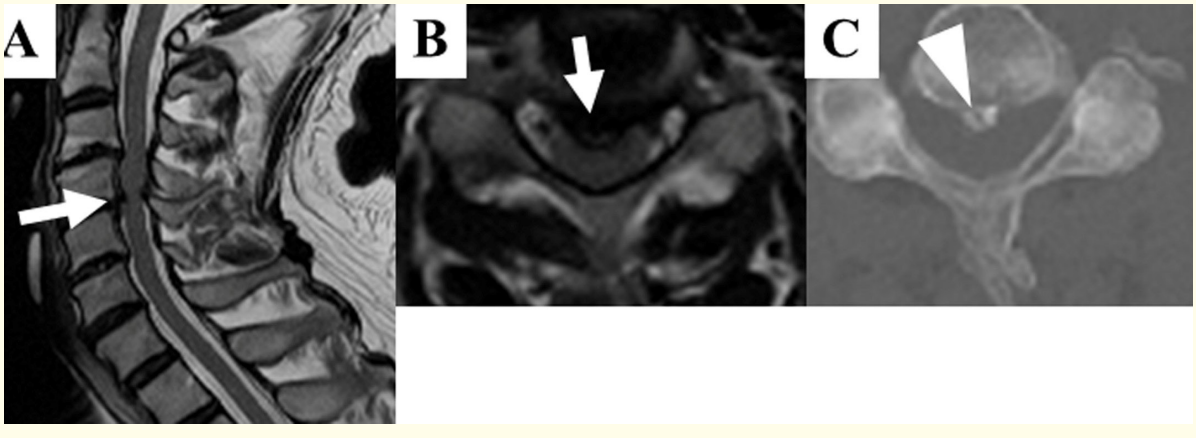

Figure 1: Preoperative MRI and CT scan.
MRI showed severe compression of anterior spinal cord at the level of C4/5.
CT scan demonstrated the compression by OPLL (arrow).

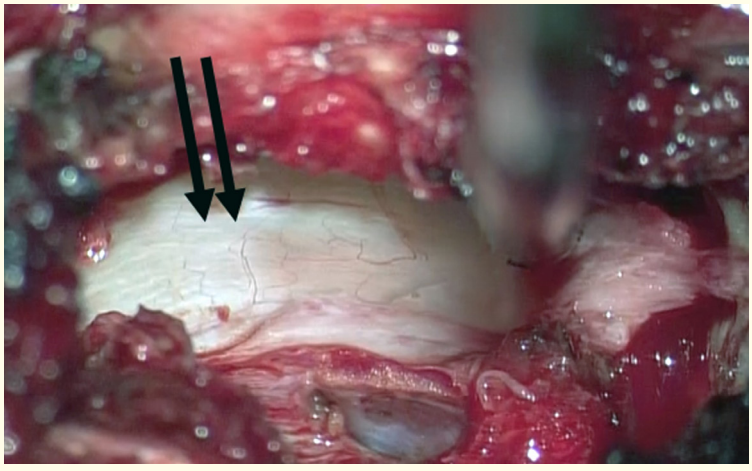

Figure 2: Surgical view.
After removal of OPLL, the bulging of the spinal cord (double arrows) was observed.

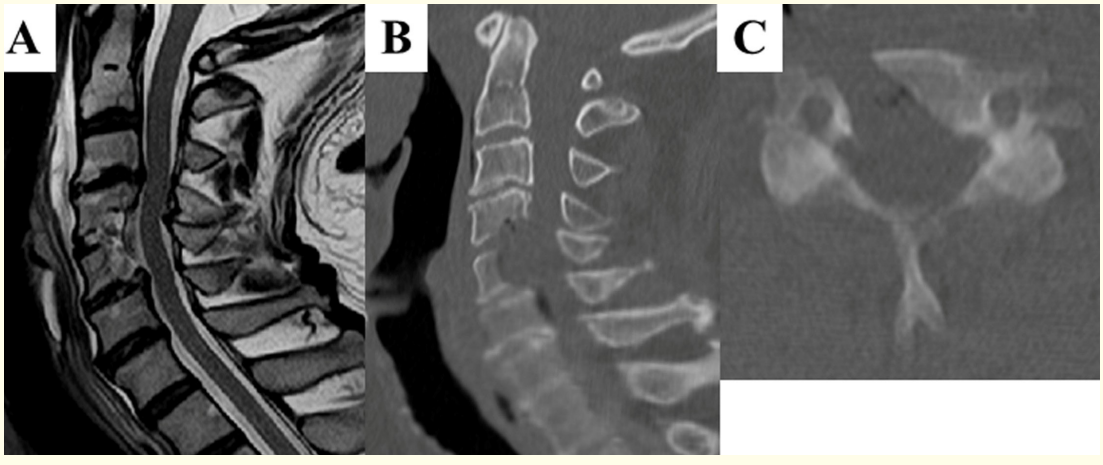

Figure 3: Postoperative MRI and CT scan.
CT scan showed complete removal of OPLL.
MRI demonstrated the sufficient decompression of the spinal cord at the level of C4/5.

Discussion

Symptoms of adjacent intervertebral disorders were reported by 25% of 374 patients with anterior cervical fusion at a mean follow-up of 6.1 years [8]. Additionally, radiographic changes were recorded in 33% of patients who underwent anterior cervical fusion while 15% of patients experienced symptomatic changes at a mean follow-up of 20 years [3]. The risk factors include older age, postoperative malalignment, multiple intervertebral fusions, and high BMI [4]. Following anterior cervical fusion, increased stress on the adjacent intervertebral space may lead to osteophyte formation and narrowing of intervertebral disc space. In the present procedure, the anterior longitudinal ligament was preserved, and the vertebral bodies and discs were only partially removed, hence, without a need for fixation using a bone graft or other means. Therefore, our technique demonstrated less effect on the adjacent vertebrae as symptoms associated with adjacent intervertebral disorders were not observed.

Postoperative cervical spine deformity was observed in only two patients who underwent anterolateral partial vertebrectomy at a mean follow-up of 3.8 years, one of whom showed preoperative cervical instability [5]. Only three patients of 101 patients who underwent multilevel oblique corpectomies without fusion had postoperative cervical deformity at an mean follow-up of 3 years [8]. Furthermore, cervical deformities have been reported to occur within 6 months after surgery [5]. The present technique preserves the Lushka joint and other lateral components of the vertebral body, which may further reduce the occurrence of postoperative cervical deformity. However, this still requires a thorough long-term follow-up.

Strengths and Limitations

Postoperative management is particularly essential for elderly patients who do not require external fixation, only need to use a soft collar for two weeks, and can leave their beds as soon as possible without limitation of movement on the day after surgery. The anterolateral approach is parallel to the optical axis of the operating microscope, making it easy and safe to perform. It is also less invasive, with minimal blood loss and requires a shorter operative time, making it suitable for elderly patients seeking to improve their quality of life.

Pain in C5 territory pain has been reported as a postoperative complication [11]. However, its underlying mechanism has yet to be elucidated. It is speculated that pain occurs due to stretching of the C5 nerve root as the spinal cord shifts anteriorly following excessive decompression [11]. We found no complications of this nature when the decompression width at the front of the spinal cord is between 10 to 13 mm. However, this is a point that requires further investigation.

In terms of spinal canal volume expansion, laminoplasty using a posterior approach is advantageous and is one of the surgical options [6]. However, this procedure directly removes and decompresses anterior spinal cord compressions, including those caused by cervical spondylosis, disc herniation, and OPLL. It can be considered an essential treatment aimed at physiological improvement. We will continue to accumulate cases and analyze data to further confirm the effectiveness of this approach.

Conclusion

The anterior oblique keyhole approach was useful for anterior spinal cord lesions, with improvement in symptoms observed at an early postoperative stage. This approach is minimally invasive, can be applied to multi-intervertebral lesions, does not require bone grafting, and does not cause postoperative limitation of cervical motion, making it suitable for elderly patients who aim to improve their quality of life. Further investigations should be conducted to evaluate other approaches and complications not covered in this study.

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Conflict of Interest

The authors declare that they have no conflicts of interest related to the publication of this study.

Ethical Approval

The Ethical Committee of the International University of Health and Welfare approved all procedures used in this study.

Submission Statement

This original manuscript has not been submitted elsewhere in part or whole.

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