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CASE REPORT

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Anterior cervical corpectomy and fusion-derived adjacent segment disease managed via channel-repairing anterior endoscopic transcorporeal cervical discectomy: a case report

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Abstract

Background Management of anterior cervical corpectomy and fusion (ACCF)-derived adjacent segment disease (ASD) represented a challenge facing the surgeons.

Methods A 41-year man diagnosed as C3-4 level ASD derived from C5-level ACCF surgery 13 years ago was admitted to the hospital for numbness and pain in the right shoulder and upper limb. Percutaneous full-endoscopic anterior transcorporeal cervical discectomy (PEATCD) was performed, and pre- and postoperative clinical and imaging data were collected.

Results The operation was completed within 70 min, and no clinical or radiological complication was reported. The visual analog scale (VAS) score decreased from preoperative 5 points to postoperative 1 point. Numbness was relieved postoperatively and disappeared completely at postoperative 3 months. Imaging data indicated sufficient spinal cord decompression, good channel repairing and cervical alignment.

Conclusions Channel-repairing PEATCD was successfully performed to treat ACCF-derived ASD, nevertheless, the long-term efficacy remained tracing and further clinical trials were needed to validate its efficacy.

Keywords Anterior cervical corpectomy and fusion, Adjacent segment disease, Cervical endoscopy, Channel repair

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Introduction

Adjacent segment disease (ASD) encompasses a large number of complications, including intervertebral disc herniation, spinal stenosis, instability, scoliosis, and fractures, following spinal fusion surgery [1]. The incidence of ASD varies widely, ranging from 0.9 to 92%, depending on the surgical approach [2, 3]. Anterior cervical corpectomy and fusion (ACCF) is a classical approach for managing cervical degenerative diseases [4]. However, AACF can damage motor function in the fused vertebra, change movement patterns, and disrupt stress distribution, leading to instability in the adjacent segment, which consequently triggers and aggravates ASD [4]. Moreover, owing to the long segment fixation and implantation of cervical vertebral substitutes, the management of ASD following ACCF is a great challenge for surgeons [4].

Revision surgeries, such as anterior cervical discectomy and fusion (ACDF), total disc replacement, and laminectomy with instrumented fixation, are considered solutions for ASD [4]. However, owing to altered stress distribution and the use of fixation instruments, revision surgeries tend to be complex and risk-laden.

Previously, we reported the effectiveness of channel-repairing percutaneous full-endoscopic anterior transcorporeal cervical discectomy (PEATCD) in cervical spondylotic myelopathy [5]. In this report, we describe the application of this novel technique for managing C3–4-level ASD derived from C5-level ACCF for the first time, providing an alternative for surgical strategy decision-making in the treatment of ASD.

Case report

A 41-year-old man had undergone ACCF at the C5 level owing to a diagnosis of cervical disc herniation (CDH) 13 years ago (Fig S1). He was readmitted to the hospital because of numbness and pain in the right shoulder and upper limb persisting for 10 months. Standard conservative treatments failed to provide symptomatic relief. Upon examination, numbness and pain were observed in the whole right upper limb; and he felt restrained in his lower limbs and felt like standing on cotton when walking. The stabbing pain did not abate. Radiography (Fig. 1a), magnetic resonance imaging (MRI) (Fig. 1b), and computed tomography (CT) (Fig. 1c and d) demonstrated a central CDH at the C3-4 segment, adjacent to the previously fused C5 segment. Additionally, ossification of the posterior longitudinal ligament (OPLL) was identified at the C2-3 level in CT scans. Imaging and physical examination results confirmed the diagnosis.

Surgery

Surgery was performed as previously described [5]. In summary, under general anesthesia, the patient was positioned in the supine position with a slight neck extension. The esophagus was identified using a C-arm with 20 mL of iohexol contrast agent injected into the gastric tube. We used the "two-finger" method to separate the esophagus, trachea, and carotid artery, creating a safe operative space. A 1.5-mm K-wire was then placed step by step and fixed in the C3 vertebra. The bony channel was prepared along the K-wire using serial dilators, a cannula, and a trephine (6.6 mm inner diameter, 7.6 mm outer diameter) (Fig. 2a). The bone plug was trephined

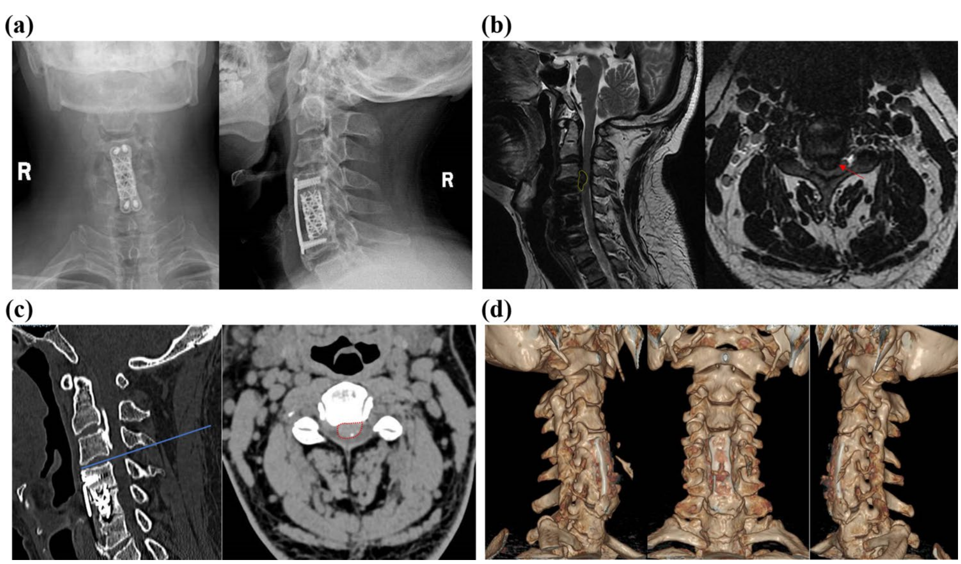

Fig. 1 Pre-operative radiological data in the second operation. (**a**) Anteroposterior and lateral X-ray image; (**b**) Representative sagittal and axial magnetic resonance imaging images (yellow circle: herniated disc in sagittal view, red arrow: herniated disc in axial view); (**c**) Representative sagittal and axial computed tomography (CT) image (blue line: location plane of the axial view, red circle: herniated disc in axial view); (**d**) 3-dimensional reconstruction of the cervical spine

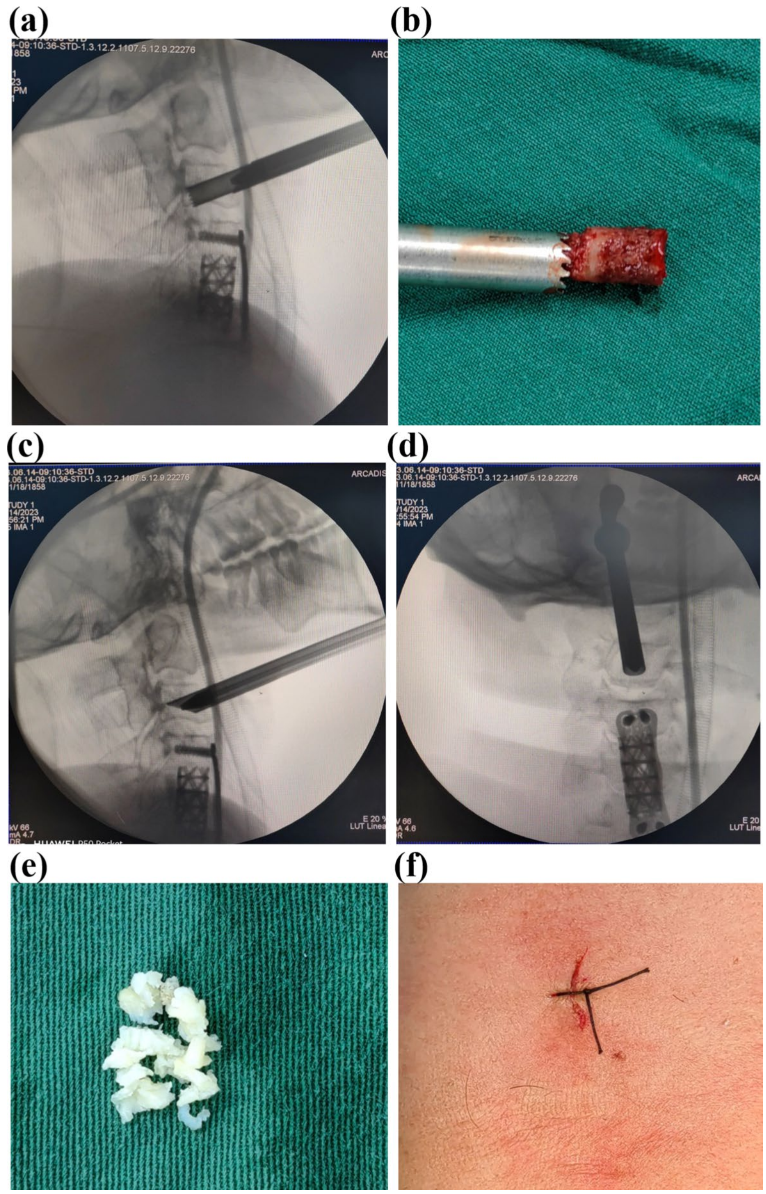

Fig. 2 Intraoperative data in the second operation. (**a**) Trephine penetrating into the posterior edge of C3 level under monitoring of C-arm; (**b**) Trephined bone plug; (**c**) Lateral and (**d**) anteroposterior view illustrating the working channel; (**e**) Extirpated intervertebral disc; (**f**) Sutured incision with a length of 7 mm

and removed (Fig. 2b). Subsequently, a spinal endoscopy system (Spinendos, Munich, Germany; 4.3 mm working channel and 6.9 mm outer sheath) was installed (Fig. 2c and d). The irregular part of the bone channel post-osteotomy was polished using a diamond drill (Nouvag AG, Goldach, Switzerland). After the target herniated lesion was separated and carefully exposed using a blunt hook, the lesion was extirpated until the dural sac re-expanded (Fig. 2e). The trephined bone plug was then re-implanted into the bony channel for repair under endoscopy, and the incision was sutured (Fig. 2f). The entire procedure was completed within 70 min.

Results

The patient was discharged on the fourth postoperative day, and no surgery-associated complications were observed. The visual analog scale score decreased from 5 points (preoperative) to 1 point on the first postoperative day. Upon discharge, the patient felt almost no pain, and numbness was relieved. The postoperative radiographic image is shown in Fig. 3a. MRI scans (Fig. 3b) revealed that the spinal cord was sufficiently decompressed and re-expanded. CT scans (Fig. 3c) and 3-D reconstruction (Fig. 3d) confirmed successful repair of the channel by the bone plug. At 3 months postoperatively, the pain and numbness disappeared completely. The imaging findings

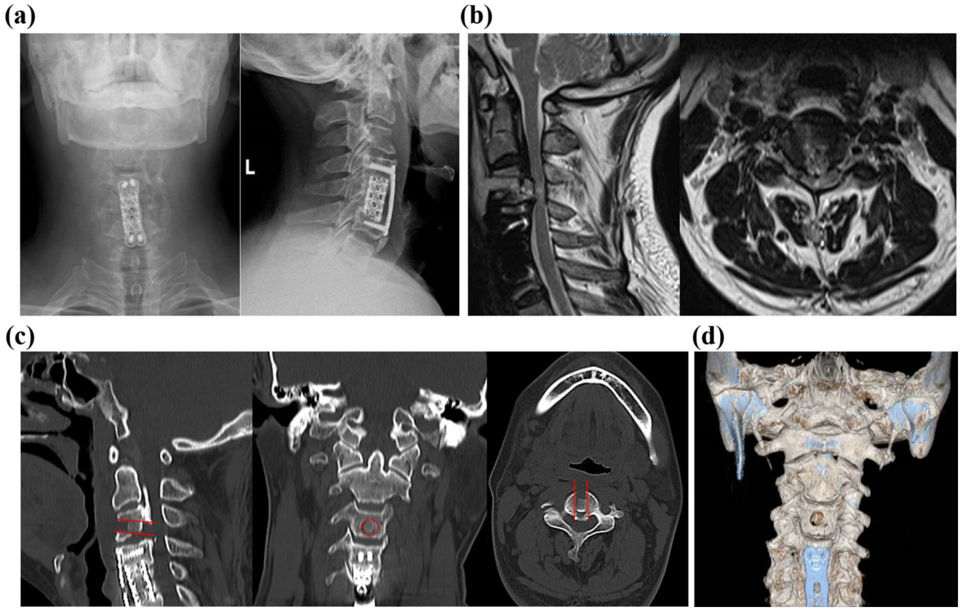

Fig. 3 Radiological images at 2 days after the second operation. (**a**) Anteroposterior and lateral X-ray image; (**b**) Sagittal and axial magnetic resonance imaging images; (**c**) Sagittal, coronal and axial computed tomography (CT) image (red mark: re-implanted bone plug); (**d**) 3-dimensional reconstruction of the cervical spine

suggested good expansion of the spinal cord and successful repair of the bony channels (Fig. 4).

Discussion

To date, the risk factors for ASD remain unclear. Factors such as congenital stenosis, high neck disability index [2], psychiatric disorders, high body mass index, large C2-C7 cervical sagittal vertical axis, and segmental kyphosis are considered potential risk factors for ASD [6]. ASD is more likely to develop in the superior cervical segment of the fusion level [7, 8]. Neither the operative segment location nor fusion length (at least one or two segments) is relevant to the emergence of ASD [3, 7]. However, some researchers have proposed that the incidence of ASD increases with the extension of fusion segments, and patients receiving multilevel fusion may experience a greater loss of global range of motion [8]. Changes in biomechanical stress, rather than the endogenous degeneration of existing vertebral levels, primarily account for the occurrence of ASD [9].

In 2019, Butler et al. systematically summarized surgical strategies for preventing cervical ASD [10]. They proposed non-fusion alternatives, suggesting that sagittal alignment should be restored. Appropriate distraction (0.5–1-fold) of the intervertebral space has been suggested to prevent the incidence of ASD [11]. Cervical ASD can be treated with ACDF/ACCF revision, posterior fusion, laminoplasty, or total disc replacement. In patients who had undergone one-level ACDF, no significant difference was detected between ACCF and ACDF for treating ASD [12]. A meta-analysis revealed that total disc replacement was comparable to ACDF in the treatment of ASD [13]. Additionally, ACDF revision using a stand-alone cage or anterior plate achieved similar rates of reoperation and fusion. Recently, new strategies have been developed to treat ASD. Laminectomy with instrumented fixation shows good clinical efficacy and safety in treating ACCF-derived ASD, despite a significant reduction in cervical lordosis and C2-C7 range of motion [4]. Wei et al. reported that a self-locking stand-alone cage applied from the opposite approach is a reliable and effective method to manage ASD after ACCF [14]. He et al. introduced a technique termed spinous-splitting laminoplasty with coral bone for managing cervical ASD, providing visualized anatomy and satisfactory clinical outcomes [15].

In our case, the patient underwent initial fusion surgery at 29 years, which was a risk factor for ASD. Additionally, ACCF surgery may place high stress on the intervertebral disc and interface between the titanium plate and screw, facilitating the emergence of ASD. Thus, several key points should be considered in case management. First, owing to the presence of the titanium mesh implanted during the first surgery occupying part of the C4 vertebra, it would be difficult to implant additional screws. Second, the implanted titanium mesh may occur subsidence; thus, fusion surgery with an additional cage may be unsuccessful. Third, the fusion rate in revision surgery is far lower than that in the first fusion surgery. Fourth, a second ASD may occur after the fusion operation if the intervertebral disc is excised. Fifth, scar adhesion from the first operation needs to be addressed in open surgery.

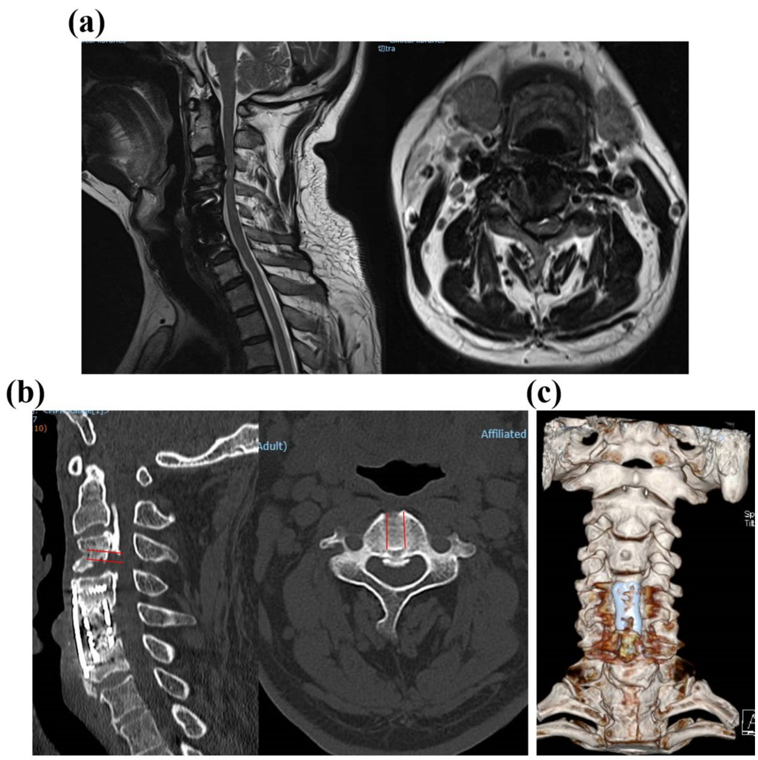

Fig. 4 Radiological images at 3 months after the second operation. (**a**) Sagittal and axial magnetic resonance imaging images; (**b**) Sagittal and axial computed tomography (CT) image (red mark: bony channel); (**c**) 3-dimensional reconstruction of the cervical spine

Finally, the existing OPLL deserves considerable attention because it increases the risk of operation. Considering these points, anterior open fusion surgery, such as using zero profile and stand-alone cage seems less favorable. In contrast, the endoscopic procedure, being minimally invasive, promotes enhanced recovery after surgery and preserves the potential for subsequent remedial surgery. Therefore, endoscopic surgery was deemed appropriate for this case.

Regarding the choice between the anterior or posterior approach, the posterior transforaminal approach causes minimal damage to critical structures, such as the trachea and esophagus, but is limited to treating lesions on the lateral myelin sheath. In this case, as the lesions mainly originated from the front, the anterior approach was chosen. As for the choice between the transcorporeal or transdiscal approach, the transcorporeal approach, by not disrupting the central nucleus pulposus, preserves the intrinsic disc and facilitates targeted decompression. Consequently, the transcorporeal approach was selected. Moreover, by replanting the bone plug, the well-repaired bone channel provided critical mechanical support for the vertebra.

To the best of our knowledge, this is the first report of the treatment of ACCF-derived ASD via this technique; however, we must acknowledge several shortcomings in this case report. First, the follow-up for this patient was limited to 3 months, which was relatively short. Determining the long-term efficacy and outcome requires further tracing, and we will report these results in the future. Second, localizing the lesion using K-wire is relatively dangerous, although it was successful in this case, and repeated radiation was necessary during this procedure. The radiation dose in cervical percutaneous endoscopic lumbar discectomy (PELD) for per level is 0.0785 mSv, and a surgeon can perform 291 PELD without radiation shielding every year to the maximum allowable radiation dose [16]. Highly effective and harmless location technology, such as a navigation system could be considered [17], to modify this technique to solve the problem of K-wire location and radiation. Third, the learning curve of this technique was high owing to the difficulties of placing the K-wire and constructing the osseous channel.

Conclusion

The channel-repairing PEATCD technique was successfully performed to treat ACCF-derived ASD for the first time. Nevertheless, further clinical trials are needed to validate its efficacy.

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12891-024-07721-6.

Figure S1. Radiological images in the first operation. (a) Pre-operative anteroposterior and lateral X-ray image; (b) Preoperative hyperextension and hyperflexion X-ray image; (c) Representative pre-operative sagittal and axial magnetic resonance imaging images (yellow circle: herniated disc in sagittal view, red arrow: herniated disc in axial view); (d) Postoperative anterolateral X-ray image.

Author contributions

WL finished the operation, conceived the original ideas of this manuscript, reviewed the manuscript and executed supervision throughout the process. JQ, HQ, GL, ZX and JA prepared the manuscript and figures. All authors have read and approved the manuscript.

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Data availability

Data are not publicly available, but can be requested through contacting the corresponding author (WL).

Code availability

Not applicable.

Declarations

Ethical approval

No ethics approval was required.

Consent for publication

The patient has given written informed consent for this case report to be published.

Consent to participate

The patient gave consent to be included in the study.

Competing interests

The authors declare no competing interests.

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