Case Report

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Upper endplate nonunion after transcorporeal percutaneous endoscopic cervical discectomy: A case report

Zhen Huang[1,*], Yuefei Li[1,*], Hui Liu[2], Ning Sun[1], Xin Liu[1], Jiabin Ren[1], Jingwei Bi[1] and Zhaozhong Sun[1]

Abstract

Background: Transcorporeal percutaneous endoscopic cervical discectomy (TcPECD) destroys the integrity of the vertebral body. We herein discuss its long-term risks and avoidance measures. Case presentation: A 44-year-old woman underwent TcPECD. Although her upper limb symptoms were relieved after the operation, the bone channel did not heal and the endplate of the segment was altered. She consequently developed chronic neck and shoulder discomfort.
Conclusion: Careful preoperative planning is needed to avoid non-healing of the bone channel following TcPECD. The diameter of the bony channel should be as small as possible and the channel should be opened at the posterior edge of the upper endplate to avoid collapse.

Keywords

Transcorporeal percutaneous endoscopic cervical discectomy, cervical spondylopathy, safety, endplate, bone channel, vertebral body

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Background

Anterior percutaneous endoscopic cervical discectomy is applicable for treatment of

[1]Department of Spine, Binzhou Medical University Hospital, Binzhou, Shandong, China
[2]Department of Neurology, Binzhou Medical University Hospital, Binzhou, Shandong, China

*These authors contributed equally to this work.

Corresponding author:
Zhaozhong Sun, Department of Spine, Binzhou Medical University Hospital, No. 661 Huanghe 2nd Road, Binzhou city, Shandong province 256603, China.
Email: szzjzw@126.com

central or paracentral cervical disc herniation. The surgical approaches used for this procedure are the intervertebral space approach and vertebral body approach.[1,3] Compared with the intervertebral space approach, transcorporeal percutaneous endoscopic cervical discectomy (TcPECD) has the advantage of minimal damage to the normal intervertebral disc and maintenance of the height of the intervertebral space of the operative segment.[1] During TcPECD, however, a bone channel through the vertebral body is created to reach the area behind the intervertebral space, which damages the vertebral body and endplate. Postoperative complications such as vertebral body collapse and endplate fractures may occur. We performed TcPECD to treat three patients with cervical spondylosis. In one of these patients, follow-up showed that the vertebral bone channel had not healed by 1 year postoperatively. This case is reported herein.

Case presentation

A 44-year-old woman experienced persistent pain accompanied by numbness and weakness in her left upper limb. Although she received conservative treatment for 6 months, the symptoms were unbearable. She showed sensory hypofunction in the C6 innervation area of the left thumb and index finger. The strength of her left biceps brachii, triceps brachii, and flexor digitorum muscles were grade III, and the bilateral Hoffman's sign was negative. Her visual analog scale (VAS) score was 9, and her Japanese Orthopaedic Association (JOA) score was 8. Magnetic resonance (MR) imaging of the cervical vertebrae showed that the C5/6 intervertebral disc had protruded backward and toward the left and that the dura mater was compressed (Figure 1). Following admission, the patient was treated with analgesic drugs, but the effects were minimal. We communicated with the patient's family to arrange TcPECD. Postoperatively, the pain of the left upper limb disappeared, the numbness was significantly relieved, the sensation of the left thumb and index finger recovered, and the left biceps brachii and triceps brachii strength improved to grade IV. Computed tomography (CT) and MR imaging of the cervical spine showed that the dura mater was not compressed (Figure 1). The patient's VAS score was 5, and her JOA score was 10. A steroid (dexamethasone) and a diuretic (mannitol) were administered, and the patient was discharged 6 days postoperatively. Prior to discharge, her VAS score was 3 and JOA score was 14.

We re-examined the patient 3 months after the operation. Continued neck and shoulder discomfort was observed with a VAS score of 2 and JOA score of 16. MR and CT imaging of the cervical spine showed that the cervical spinal cord of the surgical segment had been completely relieved of compression and that no endplate collapse or cervical endplate Modic changes were evident (Figure 2). We advised the patient to perform functional strength exercises to relieve her symptoms. The upper limb symptoms were relieved at the 1-year postoperative follow-up. However, the patient had persistent neck and shoulder discomfort with a VAS score of 3 and JOA score of 16. Cervical X-ray, MR, and CT imaging showed mild cervical flexion deformities, mild lip-like hyperplasia at the anterior edge of the C5/6 vertebral body, C3/C4 and C4/5 instability, and Modic changes of the C6 upper endplates in Phase I (Figure 2). The patient's CT Digital Imaging and Communications in Medicine data of the cervical vertebrae were imported into Mimics 17.0 (Materialise, Leuven, Belgium) for three-dimensional (3D) reconstruction. The bone channel of the C6 vertebral body had not healed well, and the

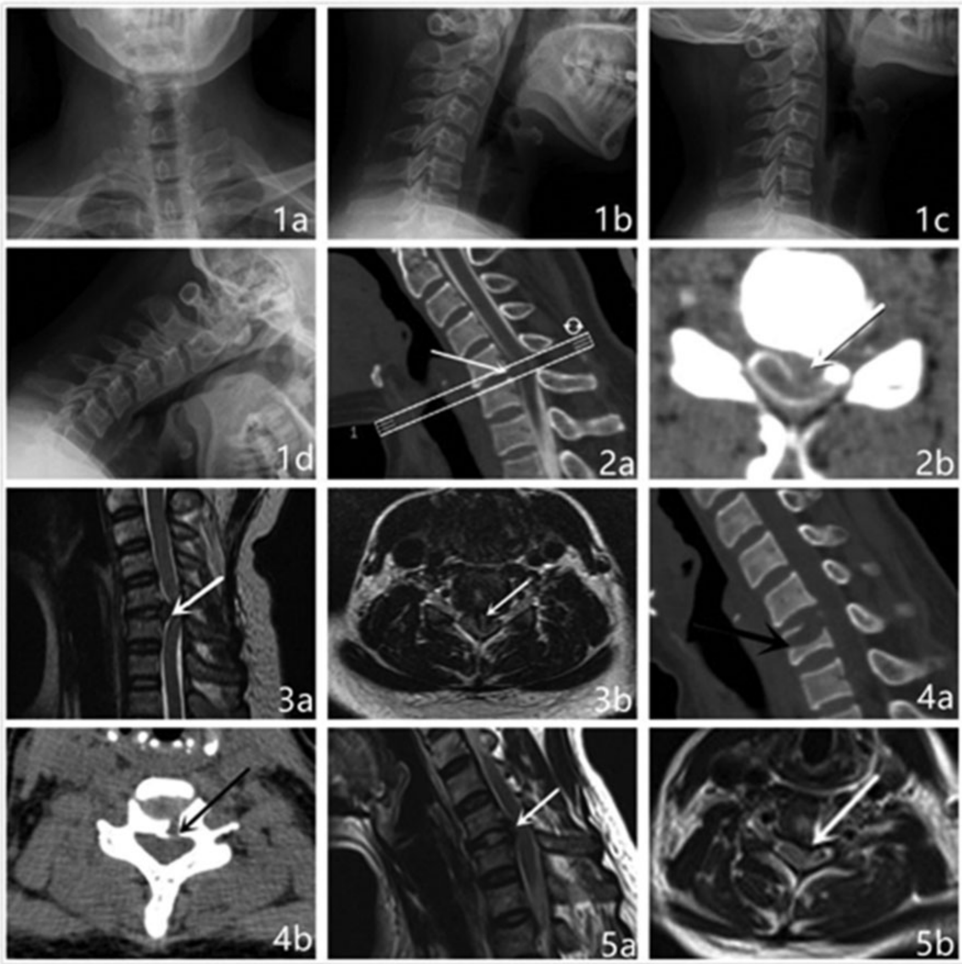

Figure 1. The white arrow indicates the herniated cervical disc, and the black arrow indicates the channel. (1a–d) Preoperative radiographs. (1a) Positive position. (1b) Lateral position. (1c) Hyperextension position. (1d) Hyperflexion position. (2a, b) Preoperative computed tomography images. (2a) Sagittal position. (2b) Cross section. (3a, b) Preoperative magnetic resonance images. (3a) Sagittal position. (3b) Cross section. (4a, b) Postoperative computed tomography images. (4a) Sagittal position. (4b) Cross section. (5a, b) Postoperative magnetic resonance images. (5a) Sagittal position. (5b) Cross section.

bone defect of the upper endplate had only healed at the posterior edge of the endplate. The central defect had not healed (Figure 3). MR imaging of the cervical vertebrae showed that the bone channel had been repaired by fibrous connective tissue hyperplasia and that osseous healing was incomplete.

Discussion

The cervical vertebral endplates are divided into bony endplates and cartilaginous endplates. The vertebral body has a shell-like structure and consists of a thin layer of cortical bone surrounding the inner cancellous bone. The upper and lower cortical bone

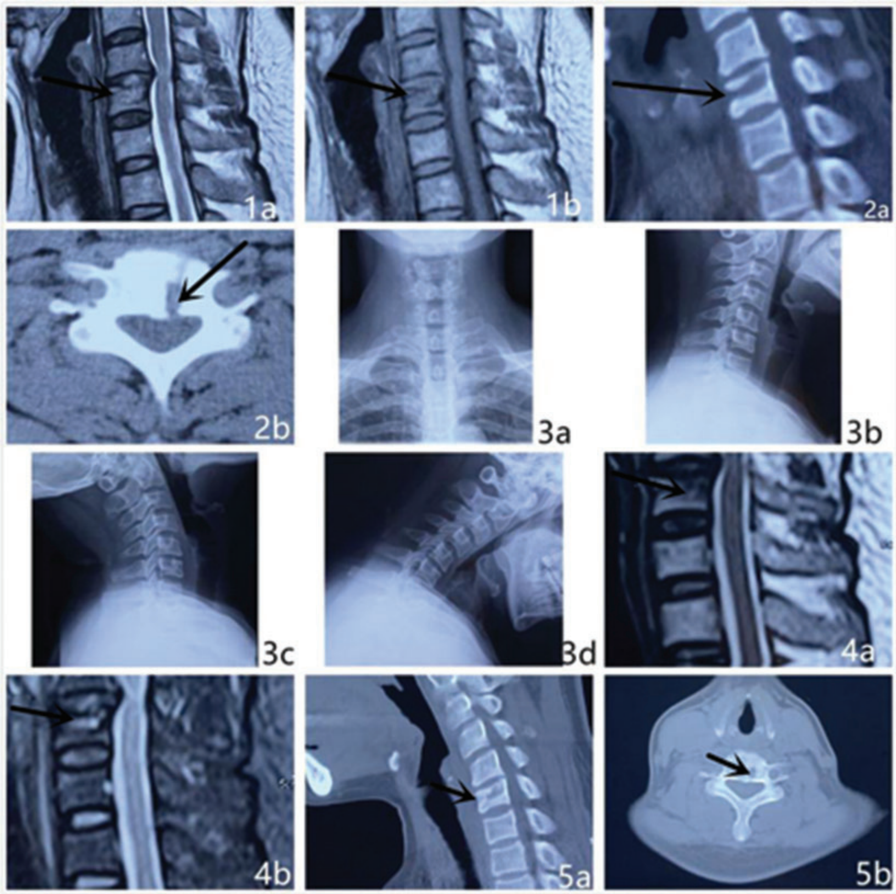

Figure 2. The white arrow indicates the herniated cervical disc, and the black arrow indicates the channel. (1a, b) Magnetic resonance images at 3 months postoperatively. (1a) T2 image. (1b) T1 image. (2a, b) Computed tomography images at 3 months postoperatively. (2a) Sagittal position. (2b) Cross section. (3a–d) Radiographs at 1 year postoperatively. (3a) Positive position. (3b) Lateral position. (3c) Hyperextension position. (3d) Hyperflexion position. (4a, b) Magnetic resonance images at 1 year postoperatively. (4a) T1 image. (4b) T2 image. (5a, b) Computed tomography images at 1 year postoperatively. (5a) Sagittal position. (5b) Cross section.

shells are termed bony endplates. The bony endplate is thin in the center and thick circumferentially, forming a circular structure. The posterior area of the upper endplate is thicker than the anterior region and has greater mechanical strength. The central cortical bone is thinner and consists of fused trabeculae with membrane-like porous structures that have low compressive strength.[2]

Compared with traditional open vertebral body approaches, TcPECD induces less severe damage to tissues around the neck, creates a smaller-diameter bone channel, and is associated with a lower incidence of postoperative complications such as vertebral body fractures and endplate collapse. Biomechanical studies have shown that endplate fracture can be avoided when the TcPECD bone channel does not damage the upper endplate. When the bone channel damages the upper endplate and the diameter reaches two-thirds the height of the

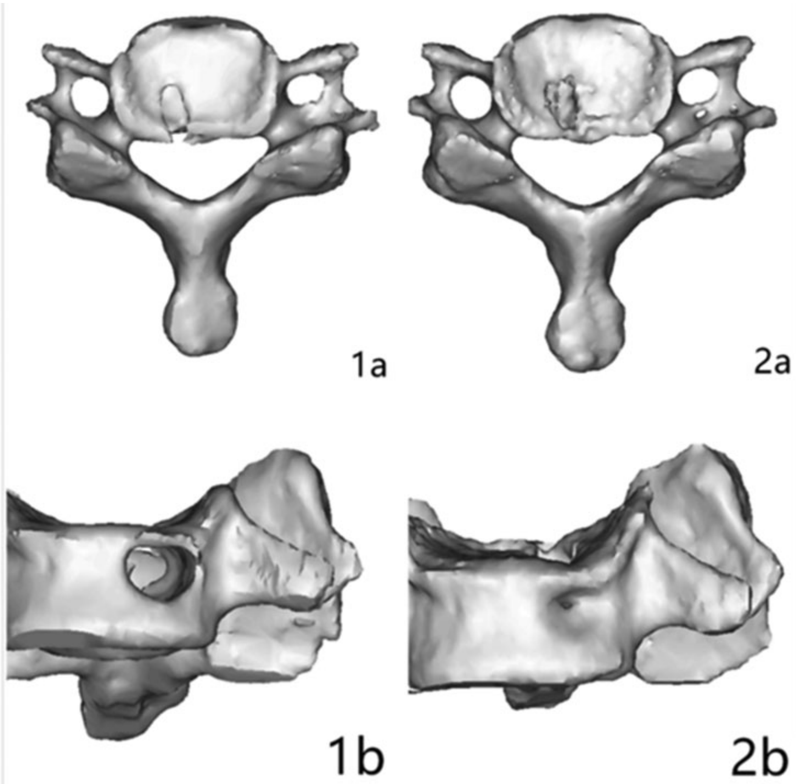

Figure 3. (1a, b) Bone channel on postoperative computed tomography. (1a) Cross section. (1b) Coronal position. (2a, b) Bone channel at 1 year postoperatively. (2a) Cross section. (2b) Coronal position.

anterior edge of the vertebral body, stress concentration points appear at the opening of the endplate and are mainly concentrated at the edges of the opening center. When the diameter of the opening is increased, the stress level increases and peaks when the opening diameter reaches two-thirds to five-sixths of the anterior edge of the vertebral body. This increases the risk of endplate fracture.[5] In the present case, the patient's postoperative 3D CT images showed that the diameter of the TcPECD bone channel was 8.18 mm and that the height of the anterior edge of the C6 vertebral body was 11.68 mm, with a diameter exceeding two-thirds the height of the anterior edge of the vertebral body. According to the 3D images, the bone channel was open near the center of the upper endplate. The cortical bone in this area was relatively thin, and the concentration of stress in the center of the upper endplate easily led to an endplate fracture, thus affecting the surgical outcome. One year after the operation, CT images and 3D reconstructions showed that the healing of the vertebral bone channel and upper endplate was poor and that only the posterior edge of the upper endplate had undergone bony healing. One year after the operation, MR imaging of the cervical spine showed Modic changes in the upper endplate of C6, suggesting the presence of microfractures in the endplate. The patient developed long-term neck and shoulder discomfort. Radiographs in cervical hyperextension and hyperflexion showed instability of the adjacent cervical segments and accelerated cervical degeneration.

In summary, TcPECD is associated with a risk of long-term postoperative endplate fractures caused by delayed healing or nonhealing of the upper endplate. We propose that surgeons consider the following five points. First, the optimal indication for TcPECD is free cervical disc herniation at the posterior lower region of the intervertebral space and posterior edge of the vertebral body. Second, TcPECD establishes a bone channel to reach the posterior region of the intervertebral space, which inevitably damages the upper endplate. We suggest opening the posterior edge of the upper endplate, in which thicker cortical bone is present. Third, because of the stress concentration on C5/6,[4] preoperative planning should be performed in this segment to avoid vertebral body fracture caused by the excessive diameter of the bone channel. Fourth, for patients with a central defect of the upper endplate caused by the bone channel, attention should be paid to maintain the normal physiological curvature of the patient's cervical spine and thus avoid forward movement of the stress concentration point of the upper endplate caused by cervical kyphosis deformities,[4] which could result in endplate fracture. Finally, patients with severe degeneration of the adjacent segments, severe cervical kyphosis, or osteoporosis have a higher risk of endplate collapse and vertebral body fracture. Preoperative evaluations should therefore be strictly performed in these patients.

Patient consent

The patient consented to the submission of this case report to the journal.

Ethics statement

The study protocol was approved by the Binzhou Medical University Research Ethics Committee.

Declaration of conflicting interest

The authors declare that there is no conflict of interest.

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