Our first experience with cervical expandable cage for vertebral body reconstruction

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Abstract: Vertebral body reconstruction after corpectomy using expandable cage has become a common surgical procedure especially at thoracic level. The recent published papers describe the successful use of expandable cages for cervical vertebral body reconstruction. In this paper we present our first experience with expandable cervical cage in the reconstruction of the cervical spine in a patient with cervical spondylotic myelopathy (CSM)
Key words: corpectomy, expandable cage

Introduction

Cervical spine corpectomy is a frequent surgery in various pathological situations such as progressive degenerative process, spinal metastasis, infection, and trauma. The surgical procedure for anterior column reconstruction due to spinal instability, neurological deterioration, or failure of non-operative treatment was represented for a long period of time by using autogenous bone grafts such as iliac crest graft. Also, pseudoarthrosis, donor-site morbidity, fatigue failure, graft subsidence and graft dislodgement are very well documented complications in the literature for the use of bone graft in spinal fusion. A solution for these issues was the developing of the first implant systems types for vertebral reconstruction to ensure goals of stability, axial load-bearing resistance, large interbody-bone interface, sagittal alignment and height restore.

Although these titanium mesh cages have proved its usefulness some technical problems have been encountered in regards to optimal placement of a nonexpandable spacer. The exact matching of the implant into the corpectomy defect is often difficult because of predefined endplate angle and height of cage. If the need for a mechanical adjustment by cutting the cage is required correct rotation during placement must be ensured due to risks of implant tilting and finally of construct failure. In addition, the need of cage removal due to intraoperative displacement of the implant usually results in a severe deterioration of the vertebral end-plate integrity. In an attempt to overcome the

technical problems of nonexpandable cages, various expandable cages have been developed. These devices offer the advantage of in situ height adjustment and opportunity for kyphosis correction.

In the present study we report our first experience with a cervical expandable titanium cage for vertebral body reconstruction from Ulrich Medical, Ulm, Germany.

Implant Characteristics

The anterior distraction device (ADD) (Ulrich Medical, Ulm, Germany) is an implant made of titanium alloy (TiAl6V4). It is used for reconstructing the anterior column of the cervical and upper thoracic spine from C3 to T3 after complete or incomplete corpectomy. ADD is available in 3 outer diameters (12, 14, and 16 mm) with 0-degree (or 6-degree) fixed angulation of the cranial end piece and 0-degree fixed angulation of the caudal end piece. The small central cavity can be filled with bone. An expansion instrument is inserted into a bore of the distraction ring, and the cage is distracted by counterclockwise rotation of the ring. The distraction ranges extend from 10 to 13 mm to 39 to 65 mm. a central screw is used to unlock the device to the desired size. Additional anterior plating is necessary (Figure 1) (5, 9).

History and examination

A 53-years-old male patient who suffered from five months by bilateral cervicobrachialgia had addressed to our emergency department for a progressive cervical myelopathy syndrome with numbness and weakness predominantly to left arm.

He suffered from this progressive neurological deficit for four weeks and the Modified JOA score was 12 (moderate myelopathy) at admission (4).

Imaging - plain radiographs and MRI (Figure 2) of the cervical spine revealed a C5-C7 ossification of the posterior longitudinal ligament (OPLL), C5-C6 and C6-C7 median disc protrusion. The images revealed also a median subsidence of C6 vertebral with inflammatory reaction.

Figure 1 - ADD anterior distraction device from Ulrich Medical, Ulm, Germany (9)

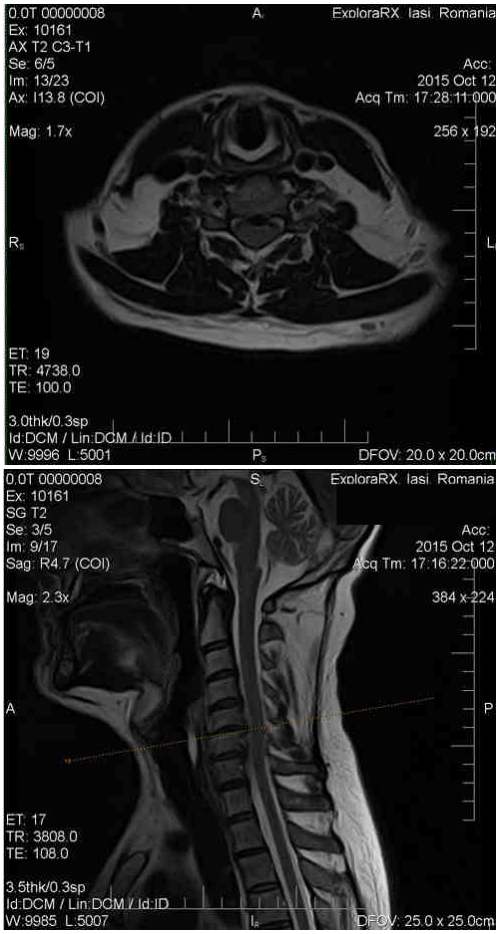
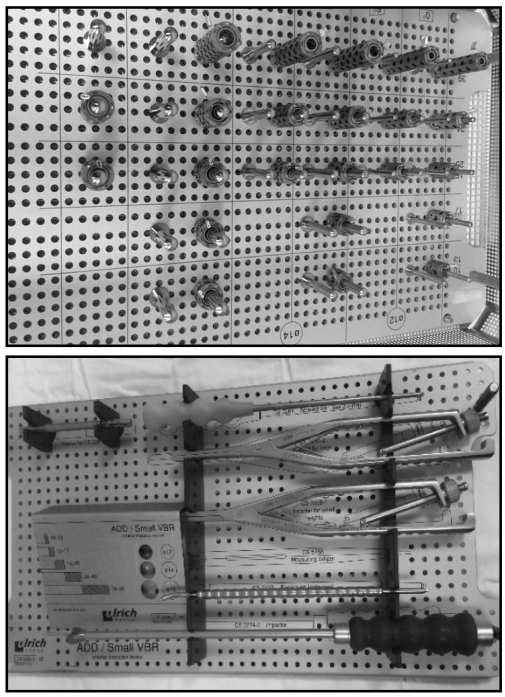


Figure 2 - T2 IRM images in axial and sagital projections showing C5-C6 and C6-C7 median disc protrusion and C5-C7 OPLL

Surgical technique – standard right anterior approach with corpectomy of C6 spinal cord decompression and OPLL resection at C5-C7 was performed. Following the corpectomy procedure, the endplates are prepared and the measures of the defect size and endplate diameter are obtained. Then, under fluoroscopic guidance the cage (filled with bone chips from corpectomy) is placed and expanded to a length close to that needed to be. Before optimal cage placement into the defect, it is tightly packed with autogenous bone. When the ideal position is reached, the cage is carefully expanded to engage or fix into the endplates. For a correct lordosis or kyphosis the expandable cage can be supplementary adjusted. Finally, anterior plating (uNitas, Ulrich Medical, Ulm, Germany) is placed from C5 to C7. The X-ray confirms that the expandable cage is properly implanted and a good alignment of cervical spine is obtained by the anterior construction. Postoperative course was uneventful.

The patient was sent to a rehabilitation center 5 days after the surgery. At follow-up control, 2 months later the Modified JOA score was 15 (mild) (Figure 3).



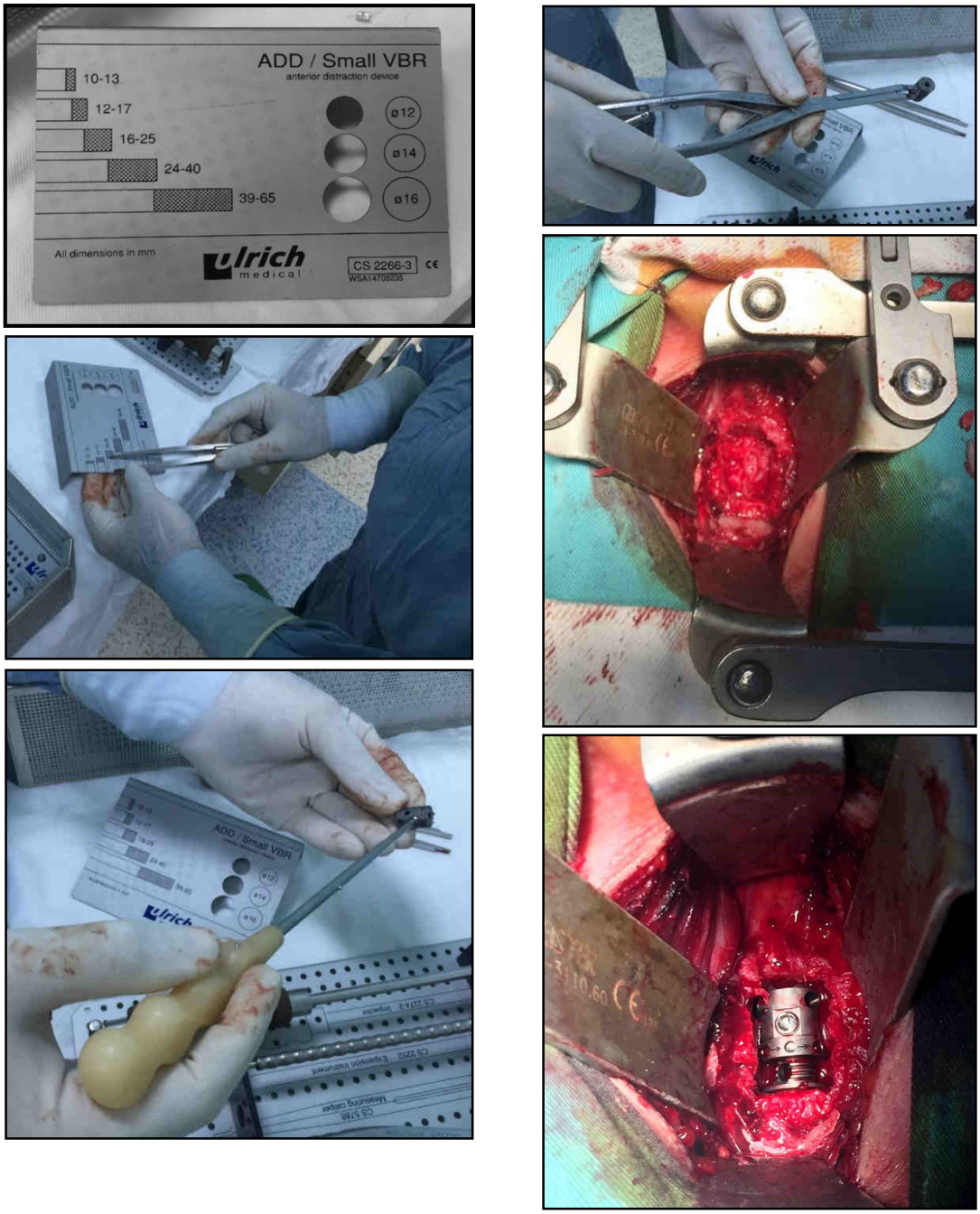


Figure 3 - Intraoperative images showing anterior distraction device kit from Ulrich Medical and different operative times

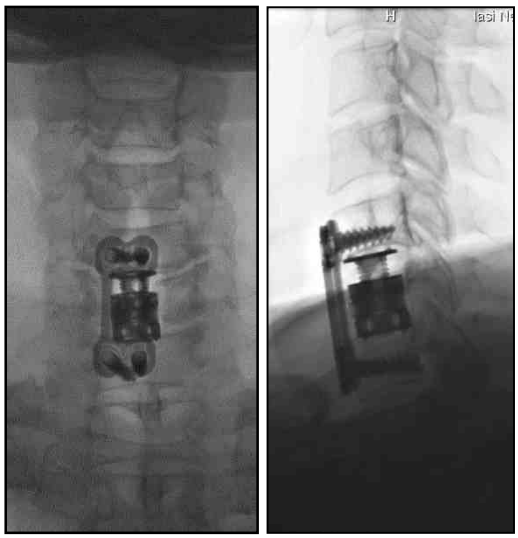


Figure 4 - X-ray showing expandable cervical cage properly implanted and a good alignment of cervical spine by anterior cervical plate fixation

Discussions

The uses of expandable cages were described in the literature within the past decade, but their use in the cervical spine has been limited. The most common reported indications of these implants are degenerative spondylosis, trauma, osteomyelitis, tumor, deformity, and ossification of the posterior longitudinal ligament. Usually the cervical vertebral reconstruction technique with expandable cage involve additional placement of an anterior plate or posterior supplemental fixation.

Almost all manufacturing companies offer implant devices with modular construction and variable core diameters, heights, shape, size, angle and endcap footprint. This range on the characteristics of these implants offer to surgical team the possibility in creating an optimal sized and contoured construction for the corpectomy defect. Most of the devices are made of titanium, but there are versions made of PEEK and some have an incorporated anterior fixation system.

Due to the complex biomechanical profile of cervical spine represented by marked flexion/extension, axial rotation, lateral bending and compression/ distraction, the major concern with the use of expandable cages is overdistraction of the cage, which could result in neurologic injury and/or structural damage (3, 5). The study published by Yoganandan et al. (12) showed that excessive expansion of the cage with resulting injury is easier in the cervical spine, as a greater distraction is achieved at a significantly lower force. Even so, the only complications mentioned by literature due to overdistraction were transient C5 palsy [Arts and Peul (1)] and a nerve root injury [Shen et al. (8)] (5).

The numerous previous studies have shown that supplementation of cervical vertebral reconstruction by expandable cage with anterior plating or posterior fixation system, or both, resulting in a decrease of range of motion in flexion-extension, lateral bending, and axial rotation compared with autograft alone. Long studies also showed that supplemental fixation is necessary in two or three-level corpectomy and in most of the cases even for a one-level corpectomy. The majority of authors describe the use of only an anterior plate for a one-level corpectomy, while for a two-level corpectomy, additional posterior supplemental fixation is often required if there is poor bone quality (2, 5, 10).

The lower fusion rate of expandable cages due to their limited surface area for fusion offered by a large footprint and less amount of bone graft that can be placed within the cage was another problem debated in the literature.

The recent studies with longer periods of follow-up have shown that fusion rates for expandable cages are not significantly different than prior reported literature for structural bone grafts and fixed cages (4, 6, 7, 11).

Although, currently there are no large studies on the effect on lordosis and segmental height of expandable and fixed cages, most reported results showed that expandable cages generally allowed for a gain in cervical lordosis for both single and multilevel constructs (1, 2, 5).

Subsidence of the fixed cage is a widely recognized complication that has been observed at all levels of the spine. Even if it is not always clinically significant this should be taken into attention. Given these inconveniences, expandable cage may offer an advantage by their modular adjustable configuration making it easier to fit flush against the end plate, and the different end plate footprints may allow a more uniform distribution of stress over the end plate.

Conclusions

The recent advances in spine surgery allow us a full mechanical reconstruction of the cervical spine. The cervical expandable cages offer to surgeon a viable solution for cervical vertebral body reconstruction. However, despite important progresses, cervical spinal interventions with restoration of lost functions still remain a challenge for most surgical teams.

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