



## Clinical Study

# Complications associated with cervical vertebral body replacement with expandable titanium cages



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## ABSTRACT

Our aim was to analyze complications and risk factors for cervical vertebral body replacement (VBR) with expandable titanium cages (ETC). Fifty patients; 22 women and 28 men, mean age 61 years, undergoing cervical VBR from 2010 to 2015 were analyzed. Complications were stratified by hardware-association (HA). Univariate and multivariate logistic regression was used to identify independent risk factors. Single, two and three level corpectomies were performed in 32, 15 and 3 patients respectively. A circumferential approach was necessary in 16 cases. At mean follow-up (7.3 months) 66% of patients had recovered. Radiological data showed a significant distraction (2.60 mm,  $p < 0.0001$ ) and lordosis ( $5^\circ$ ,  $p = 0.001$ ). Twenty-three patients experienced 42 complications; 18 HA, 24 non-HA and 24% needed revision surgery. The number of corpectomy levels and surgical approach significantly correlated with the risk of complications ( $p = 0.001$ ), especially non-HA complications ( $p = 0.002$ ). On multivariate analysis, only the number of corpectomy levels ( $p < 0.02$ , odds ratio 5.48, 95% CI 1.31–22.91) was a significant predictor of complications. We conclude that ETC are efficacious devices for cervical spine VBR, however, when used for more than 1 level, the corpectomy complication rate significantly increases.

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## 1. Introduction

Anterior cervical corpectomy with vertebral body replacement (VBR) remains one of the complex and technically demanding procedures for cervical spine pathologies. Controversy still surrounds the choice of implant for VBR [1]. Besides autogenous bone grafts, VBR can be performed using various implants made of materials ranging from polyetheretherketone (PEEK) [2] to titanium [3]. Expandable titanium cages (ETC) have sought to widen the surgical armamentarium allowing for precise distraction and quick implantation [3] via *in situ* adjustment to fit the height of the corpectomy defect [4]. However, following the initial wave of enthusiasm, disadvantages have been reported. Apart from the high costs, stated biomechanical disadvantages include the risk of over distraction, tilting and stress shielding [3]. Furthermore, studies have shown that although expandable VBR systems can serve as solid anterior column constructs, restoring sagittal height and alignment, the complication and re-operation rates, especially in tumor patients, are high [4]. These conceptions emphasize that other than technical demands and biomechanical challenges instigating hardware failure, patient associated factors also need to be differentiated.

Currently, substantial data for VBR for a homogenous patient population receiving a single expandable cage system is lacking [3]. We therefore conducted a prospectively followed case series assessing the short-term complications encountered after implanting an ETC for cervical pathologies. We aimed at assessing risk factors for complications emphasizing hardware-association (HA).

## 2. Patients and methods

### 2.1. Study population

Fifty consecutive patients undergoing single, two or multilevel cervical corpectomy with implantation of an ETC in a tertiary neurosurgical center between October 2010 and May 2015 were included in the study. Indications for surgery were grouped into degenerative, infectious, neoplastic and traumatic causes. Two independent observers blinded to patient outcome, reviewed medical charts and operative reports. All patients consented to have their medical records accessed for the study.

### 2.2. Clinical evaluation and complication assessment

Demographic parameters were age, sex, timing of surgery and preoperative comorbidity status. The latter was evaluated by the

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American Society of Anesthesiologists (ASA) classification. Presenting symptoms consisted of neck pain, radiculopathy, myelopathy or a combination of the former. Perceived recovery was recorded according to the previously described Likert scale [5]. In line with former reports [6] encountered complications were meticulously computed and further classified into medical, neurological, surgical and HA complications. The latter were assessed for the VBR and plate/screws separately and further subclassified as malplacement (wrong placement at initial operation) and displacement (loosening or failure during follow-up). Revision surgeries and reasons for them were also recorded.

### 2.3. Radiographic evaluation

CT scan, MRI and conventional X-ray scans were conducted pre- and postoperatively in all patients. Radiographs were reviewed for alignment, hardware position and hardware failure. In detail, regional angulation (RA) was evaluated by measuring the angle between the normal endplate above and below the affected segment. Kyphosis was documented as “positive” and lordosis as “negative” angulation. The segment height was evaluated by measuring the height of the involved vertebral segment. The coronal VBR alignment angle in relation to the upper cervical vertebra was also assessed. Figure 1 shows an example of measurements made.

### 2.4. Surgical technique

Under general anesthesia a standard right-sided anterior approach to the cervical spine was performed. Corpectomy was performed under the microscope with high-speed drills and various rongeurs. Decompression of the dural sac and nerve roots included removal of the posterior longitudinal ligament. The

endplates were cleaned of cartilage, paying particular attention to leave the cortical bone undamaged to prevent a collapse of the implant into the vertebral bodies. VBR was performed by implanting an anterior distraction device (ADD); (Ulrich Medical, Ulm, Germany) together with an anterior plate, which was fixed with monocortical screws. The appropriate ADD was chosen according to intraoperative corpectomy defect measurement. To generate a homogeneous study population, the same surgical procedure and implants (ADD) were employed for all patients. Dorsal instrumentation for cases where circumferential spondylosis was indicated (when preoperative imaging showed severe kyphosis) was performed in a two-stage surgery.

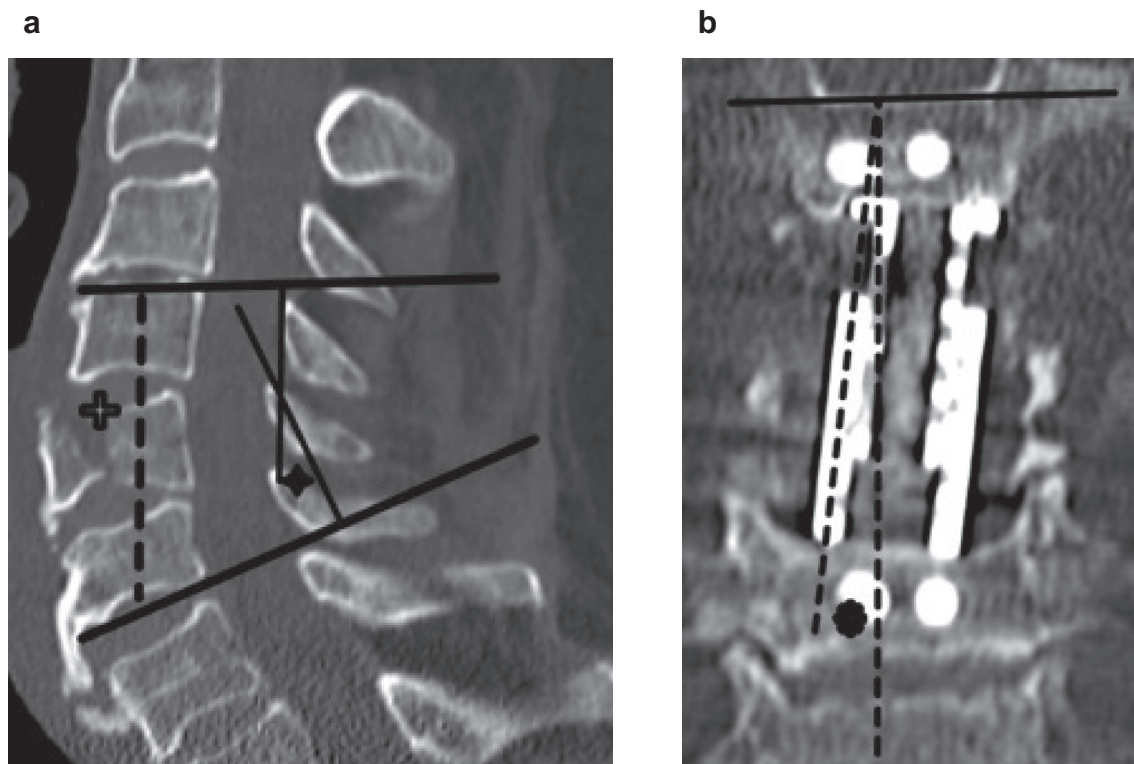
### 2.5. Statistical analysis

Statistical evaluation was performed using SPSS software (version 22.0) (SPSS, Chicago, IL, USA). Descriptive parametric data was presented as means  $\pm$  standard deviation (SD). Student's paired 2-tailed t-tests were used for comparisons. Statistical significance was set at  $p < 0.05$ . Factors independently associated with occurrence of complications were assessed by univariate analysis. Independent variables proving significant here served as covariates for multivariate logistic regression analysis.

## 3. Results

### 3.1. Patients characteristics

Demographic, clinical data and perioperative characteristics of the 50 patients, constituting the study group, are summarized in Table 1. Mean age was 61 years (range, 31–84 years), with slightly more men than women (28 men vs. 22 women). Mean follow-up period was 7.3 months. Twenty-eight patients (56%) were operated



**Fig. 1.** CT images of a 57-year-old woman with a traumatic fracture of C5 preoperative sagittal (a) and postoperative coronal (b) after corpectomy of C5 and vertebral body replacement (VBR) with an anterior distraction device (ADD); (Ulrich Medical, Ulm, Germany). The images show gained segmental height (+) from 41.3 mm to 45.6 mm and improved regional angulation (x) from 3.4 to 5.6 degrees, as well as measurement of coronal VBR (ADD) angle (\*).

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