Journal of Clinical Neuroscience 19 (2012) 402–405

Contents lists available at SciVerse ScienceDirect

Journal of Clinical Neuroscience

journal homepage: www.elsevier.com/locate/jocn

Clinical Study

Use of titanium expandable vertebral cages in cervical corpectomy ☆

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ARTICLE INFO

Article history:
Received 7 June 2011
Accepted 25 July 2011

Keywords:
Cervical spine
Corpectomy
Expandable cage
Titanium

ABSTRACT

We aimed to investigate the usefulness of titanium expandable cages for vertebral body reconstruction after anterior cervical corpectomy. The records of 29 patients treated with expandable titanium cages for a variety of indications were analysed retrospectively. There was evidence of fusion in all patients. There was no radiographic evidence of more than 4 mm subsidence throughout the series. There were no hardware failures. Our results show that expandable titanium cages are safe and useful in anterior cervical corpectomies for providing adequate anterior column support and solid constructs without significant hardware complications or the risk and morbidity associated with the use of strut allograft or autograft.

1. Introduction

Cervical corpectomy is a common procedure for degenerative stenosis, trauma, instability, infection, deformity, and tumor. Bone grafting techniques include iliac crest autograft, allograft, or fibular strut graft.[1] Iliac crest autograft has been considered the gold standard of graft material, but morbidity associated with harvesting has put the procedure into question.[2,3] Autogenous fibula strut graft harvesting can incur significant donor-site complications.[4] Efficacy of fusion with allograft bone has been controversial as to whether it has equivalent fusion rates to autograft.[5,6]

The characteristics of a vertebral body substitute should include stability, axial load-bearing resistance, a large interbody–bone interface to facilitate fusion and prevent migration, and restoration of height and sagittal alignment.[7] Reconstruction with titanium mesh cages after cervical corpectomy has eliminated the need for autogenous tricortical bone grafts.[8–10] With this procedure, the disadvantages of autograft harvesting, which include fracture and donor site pain, are avoided.[2–4] Results of using titanium mesh cages have shown significant stability and low complication rates.[8–10] However, optimal placement of a non-expandable cage can be challenging since it is not adjustable to the height of the corpectomy defect.[1,7] In response to this problem, various expandable cages have been created that can be adjusted *in situ* to better fit the height of the defect. However, a paucity of reports exists concerning the use of titanium expandable cages.

In this retrospective case series, we describe our experience with expandable titanium cages in the cervical spine for a variety of indications.

2. Materials and methods

Institutional Review Board approval and informed consent from all patients was obtained for this study. Between September 2007 and August 2010, 29 consecutive patients (nine women, 20 men) underwent a one-level, two-level, or three-level cervical corpectomy with insertion of an expandable titanium cage (Ulrich, Ulm, Germany). All procedures were performed at the same institution (Tampa General Hospital) by the senior author (JSU). Patient ages ranged from 14 years to 81 years (mean: 48 years). A corpectomy was indicated in 12 patients with spondylosis, 11 with traumatic fracture or ligamentous injury, two with osteomyelitis, one with a deformity, one developmental condition, one hardware failure, and one tumor (Table 1).

The cervical approach was through a transverse skin incision if only two cervical disc levels (one-level corpectomy) were involved; and an oblique skin incision was used if three or more disc levels were involved. Corpectomies were performed either with or without adjacent one-level or two-level anterior cervical discectomy and fusion (ACDF) depending on the extent and nature of the pathology.

Corpectomies were performed using rongeurs and a high-speed drill.[11] The posterior longitudinal ligament was removed in all patients. To prevent subsidence into the vertebral bodies, disc material was removed from the endplates without damaging the cortical bone.

After corpectomy, 12–14-mm cylindrical expandable cages were filled with autograft from the index vertebrae. In patients

☆ Portions of this work were presented in poster form as proceedings at the 27th Annual Meeting of the AANS/CNS Joint Section on Disorders of the Spine and Peripheral Nerves held at Phoenix, Arizona, USA in March 2011.

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doi:10.1016/j.jocn.2011.07.030

Table 1
Clinical and demographic data of 33 patients who underwent anterior cervical corpectomy with an expandable titanium cage

Characteristic	Number (%)
Sex	
Male	20 (68.9)
Female	9 (31.1)
Mean age (years)	48 (range, 14-81)
Diagnosis	
Spondylosis	12 (414)
Trauma	11 (38.0)
Infection	2 (6.9)
Deformity	1 (3.4)
Tumor	1 (3.4)
Hardware failure	1 (3.4)
Developmental condition	1 (3.4)

with an infection, the cages were filled only with hydroxyapatite and calcium triphosphate (Actifuse, Baxter, Deerfield, IL, USA). The cages were placed in the corpectomy defect and then expanded to make contact with the inferior endplate of the superior vertebra and the superior endplate of the inferior vertebra. In all patients an anterior titanium vertebral plate (Orthofix, Lewisville, TX, USA) was placed bridging the entire construct, with 3.5 mm × 14 mm variable angulation screws placed into the superior and inferior vertebrae.

Posterior fixation was also performed in nine patients with multilevel corpectomy or single level corpectomy with signs of posterior instability, as shown on CT scans, MRI, and radiographs (Fig. 1). Titanium polyaxial lateral mass screws (3.5 mm × 14 mm, Nuvasive, San Diego, CA, USA) were used in the subaxial cervical spine and placed by the technique described by Magerl.[12] Pedicle screws were placed using 4.0 mm × 22 mm screws when the construct extended to T1 (Nuvasive).

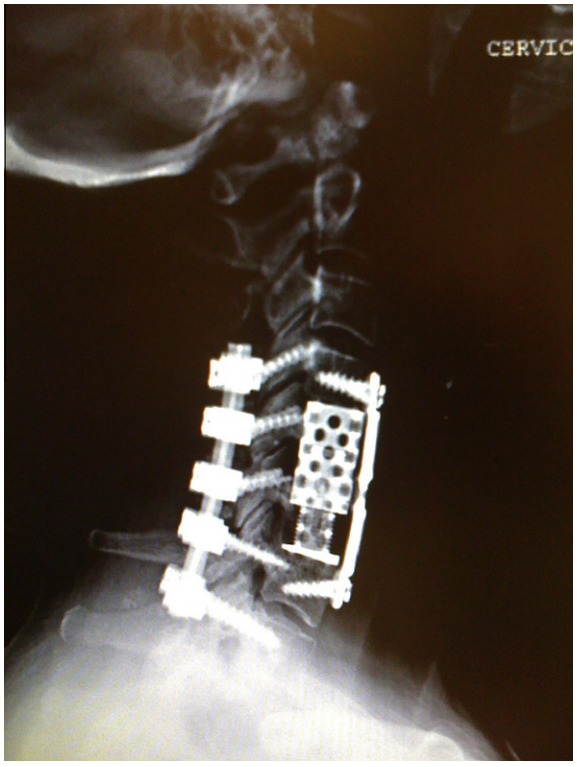

Fig. 1. Lateral radiogram of a C5 to C6 corpectomy with an expandable titanium cage and a C4 to C7 anterior plate with posterior fixation from C4 to T1.

All patients had a subplatysmal Hemovac drain placed for one day. Patients were immobilized in a hard cervical collar (Aspen Medical Products, Irvine, CA, USA) for three months. In patients with significant anterior and posterior stenosis, a MRI was performed after the corpectomy to assess for posterior compression and the need for laminectomy during the second stage of posterior instrumentation.

Clinical examination and radiographs were performed at 6 weeks, three months, six months, and 12 months. Evidence of fusion was evaluated at three months, six months, and 12 months with flexion/extension radiographs. Fusion was considered present by the absence of lucency at the cage endcaps and vertebral endplates, or absence of instability, on flexion/extension radiographs.[1,13] A postoperative CT scan was obtained in some patients in whom the assessment of fusion and instability was a concern.

3. Results

In our series, 23 patients underwent a single-level corpectomy (five were in combination with an adjacent one-level ACDF; one was in combination with an adjacent two-level ACDF); four patients underwent a two-level corpectomy (of which one was combined with an adjacent one-level ACDF); and two patients underwent a three-level corpectomy without an adjacent ACDF (Table 2). Patients had a satisfactory clinical outcome in terms of pain reduction as evaluated post-operatively using Visual Analog Scale scores.

All patients achieved optimal decompression. Flexion and extension radiographs did not show any motion of the construct at 3 months, 6 months, and 12 months (average: 9.5 months; range: 3–24 months) postoperatively in all patients. Subsidence less than 4 mm was noted in two patients without resulting kyphosis or migration. There were no hardware complications related to the plates or screws. There were no clinically significant postoperative kyphotic deformities as a result of the procedures. In patients with preoperative kyphotic deformities, the mean kyphotic angle was 23.4 degrees, as measured by the technique described by Uchida et al.[14] Instrumentation in patients with a preoperative kyphotic deformity gained a mean of 20.8 degrees of lordosis and all patients in the series had an average gain of 14.5 degrees of lordosis overall. The improvement in lordosis is consistent with that described in

Table 2
Surgical procedures and complications in 29 patients who underwent anterior cervical corpectomy with an expandable titanium cage

Surgical procedures and complications	Number (%)
One-level	23 (69.7)
Without adjacent ACDF	17 (51.5)
Without posterior instrumentation	9 (27.3)
With posterior instrumentation	8 (24.2)
With adjacent one-level ACDF	5 (15.2)
Without posterior instrumentation	3 (9.1)
With posterior instrumentation	2 (6.1)
With adjacent two-level ACDF without posterior instrumentation	1 (3.0)
Two-level (with posterior instrumentation)	4 (12.1)
Without adjacent ACDF	3 (9.1)
With adjacent one-level ACDF	1 (3.0)
Three-level without adjacent ACDF with posterior instrumentation	2 (6.1)
Mean blood loss of anterior procedure (mL)	243 (range, 5-1200)
Mean duration of anterior procedure (minutes)	280 (range, 135-681)
Complications (total)	1 (3.0)
Retropharyngeal hematoma	1 (3.0)

ACDF = anterior cervical discectomy and fusion.