Journal of Clinical Neuroscience 18 (2011) 1505–1509

Contents lists available at SciVerse ScienceDirect

Journal of Clinical Neuroscience

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

Clinical Study

Three-level anterior cervical discectomy and fusion with self-locking stand-alone polyetheretherketone cages

Jian Zhou, Xilei Li, Jian Dong *, Xiaogang Zhou, Taolin Fang, Hong Lin, Yiqun Ma

Department of Orthopaedic Surgery, Zhongshan Hospital, Fudan University, 180 Fenglin Road, Shanghai 200032, China

ARTICLE INFO

Article history:
Received 11 January 2011
Accepted 28 February 2011

Keywords:
Anterior cervical discectomy fusion
Degenerative disc disease
Multilevel
Polyetheretherketone
Self-locking
Stand-alone cage

ABSTRACT

Anterior cervical plating is regarded as standard practice after multilevel anterior cervical discectomy and fusion. However, plate implantation in the anterior cervical spine poses a substantial risk of hardware-related complications. We retrospectively analyzed the efficacy and outcomes of 15 consecutive patients treated with a 3-level anterior cervical fusion using self-locking stand-alone polyetheretherketone (PEEK) cages. Patients were evaluated preoperatively and postoperatively using the Japanese Orthopedic Association (JOA) scale scores and radiographs. Clinical results were assessed using Odom's criteria. The mean JOA score (± standard deviation) improved significantly from 7.3 ± 1.5 points to 14.1 ± 1.3 points ($p < 0.05$) at the final follow-up. The outcomes were excellent for four patients (26.7%), good for nine patients (60%) and fair for two patients (13.3%). None of the patients experienced a poor clinical outcome. Thirteen patients achieved a solid fusion, after an average time of 5.7 months. The radiographic fusion rate of this procedure was 93.3%. Of 45 cages inserted in total, only four (8.89%) cages, in three patients, were found to have subsided. The degree of spinal curvature before surgery differed significantly from that immediately after surgery, and from that at the final follow-up examination ($p < 0.05$). Self-locking stand-alone PEEK cages packed with excised local osteophytes and calcium sulfate are safe and effective. This procedure can effectively restore cervical lordosis, obviate the complications related to graft harvest and screw-plate fixation, and lead to satisfactory outcomes.

1. Introduction

Anterior cervical discectomy and fusion (ACDF) has yielded good results for the treatment of cervical degenerative disc disease and is accepted as the standard operative procedure. Success of the procedure relies on a thorough decompression and development of a solid osseous fusion. Traditional interbody fusion using iliac crest bone can maintain the patency of the neuroforamen and ensure solid fusion, and an iliac crest autograft is the gold standard for interbody support.[1] However, autologous bone grafts obtained from the anterior iliac crest are associated with significant donor-site morbidity and complications, including a longer operative time, increased postoperative pain, longer hospital stays, hematoma formation and infection.[2] While the use of an allograft can eliminate donor-site problems, this type of graft is associated with high rates of pseudarthroses.[3] Continued improvements in cage technology have aimed to remove these limitations, and interbody fusion cages have been developed and widely used in clinical practice.[4]

For a single-level discectomy, a 92–100% fusion rate can be achieved with ACDF.[5] However, in multilevel discectomy, the success rate declines as the number of levels increases.[6] Lower success rates have been attributed to the increased number of grafts and interfaces that must consolidate during multilevel surgery, and the increased stresses on the multiple graft sites and the resultant motion. The interbody cage provides stability only through tensioning of the remaining ligaments; therefore, it offers little stabilization during extension because the anterior ligamentous structures are removed during the discectomy. Plate fixation may decrease the micro-movement of the cervical spine, enhance the fusion rate, and correct the spinal curve to physiological lordosis.[7] Anterior cervical plating (ACP) is often performed after multilevel ACDF as standard practice.[8] However, implantation of plates in the anterior cervical spine poses a substantial risk of hardware-related complications. The plate complication rate varies from 2.2 to 24.0% and includes hardware failure, injury of the recurrent laryngeal nerve, injury of the esophagus, injury of the spinal cord or nerve root, injury of the vertebral arteries, and wound infection.[5,9–11]

Several new devices have been developed that incorporate interbody support with supplemental fixation. These devices generally contain an interbody spacer with self-locking devices

* Corresponding author. Tel.: +86 21 64041990x3057; fax: +86 21 64432673.
E-mail address: dong.jian@zs-hospital.sh.cn (J. Dong).

0967-5868/$ - see front matter © 2011 Elsevier Ltd. All rights reserved.
doi:10.1016/j.jocn.2011.02.045

passing through the spacer into the endplates of the adjacent vertebral bodies, which limits the risk of cage migration and increases the rigidity of the fusion construct. ACDF performed with a stand-alone cage has proven to be a safe and effective procedure and clinical outcomes have been encouraging in 1- and 2-level procedures.[12,13] However, the clinical results of stand-alone cages for 3-level ACDF have rarely been reported.

We used a self-locking stand-alone polyetheretherketone (PEEK) cage to treat and retrospectively evaluate the clinical and radiological results of 15 patients with 3-level cervical degenerative disc disease.

2. Material and methods

Fifteen consecutive patients (10 male, 5 female; mean age = 57.2 years; range = 43–71 years) with 3-level degenerative cervical disc disease were included in this review between March 2007 and March 2009. All patients gave informed consent and underwent ACDF with self-locking stand-alone PEEK cages. Preoperative clinical evaluations were performed including MRI and radiographical studies of the cervical spine. Inclusion criteria were: (i) myelopathy or radiculopathy on the physical examination; and (ii) spinal cord compression visible on MRI at three disc levels. Exclusion criteria were: (i) developmental stenosis; (ii) continuous or combined ossification of the posterior longitudinal ligament; and (iii) a history of cervical spine surgery. Before surgery, nine patients had myelopathy and six had radiculopathy. None of the patients had myelopathy and radiculopathy concurrently. All patients were refractory to conservative treatment.

Operations were performed by the same surgeon at a single institution, using a standard anterior approach to the cervical spine. The basic techniques for exposure, discectomy and decompression, performed using a right-sided skin incision, were the same as described by Robinson and Smith.[14] A microscope was used in most instances during the procedure. Extensive decompression was performed including removal of the osteophytes, herniated nucleus pulposus and discectomy. The posterior longitudinal ligament was opened transversely and osteophytes possibly compressing the nerve root were removed with rongeurs or a drill. The dura mater and nerve root origins were exposed and decompressed. The endplates were abraded before fusion and the bony endplate was preserved as much as possible to prevent cage subsidence. The appropriate size for the self-locking stand-alone cage (MC+®, LDR, Troyes, France) was determined by both preoperative templating and intraoperative evaluation using a trial cage to confirm initial stability. Cages were packed with excised local osteophytes and calcium sulfate (Osteoset®, Wright Medical Technology, Arlington, TN, USA) and inserted into the disc space using an impactor (Fig. 1). After implantation of the cage, a cervical anchoring clip was placed into the lower vertebra through the anterior part of the cage to ensure primary stabilization. ACP systems were not used for any patients. After surgery, patients were allowed to sit up on the first postoperative day and walk on the second postoperative day with a soft cervical collar, which was worn for the first 3 months postoperation.

Patients received monthly check-ups at our outpatient clinics for the first 3 months and every 3 months thereafter. Neurological function was assessed at every visit. The preoperative and postoperative Japanese Orthopedic Association (JOA) scores were recorded. An independent observer, who did not attend the surgery, interviewed the patients and evaluated the clinical results based on Odom's criteria at the final follow-up.[15] Excellent and good outcomes were considered satisfactory.

Radiographs were taken before and after surgery, at 3 months, 6 months, and subsequently every 6 months after surgery. Two-dimensional CT scan reconstructions were performed when evidence of bone fusion was observed on X-ray. Fusion was assessed by: (i) the absence of motion >2 mm between the spinous processes on flexion–extension lateral radiographs; (ii) the absence of a radiolucent gap between the graft and the endplate; and (iii) the presence of continuous bridging trabeculae at the graft and endplate junction.[16] Subsidence on the radiographs was defined as cage migration of $\geqslant$3 mm into the adjacent vertebral body. Cervical spinal curvature was determined from the lateral view of the X-ray. A straight line was drawn from the posterior border of the dens to the posterior border of C7. A second line was drawn from the posterior border of C4 perpendicular to the first line; the length of this intersected line measured in centimeters equaled the degree of spinal curvature. A length of 0 mm corresponded to straight lateral spine curvature; negative values indicated kyphotic spinal curvature and positive values indicated lordotic spinal curvature.[17]

The mean ± standard deviation were determined for cervical spinal curvature and JOA scores. All results were statistically analyzed using the Student's *t*-test. A p value <0.05 was considered significant.

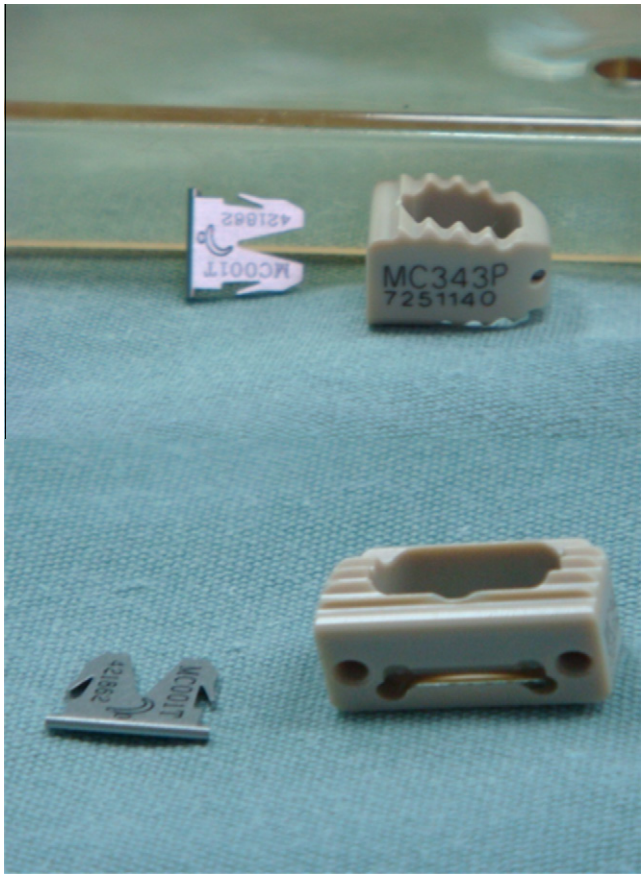

Fig. 1. The self-locking stand-alone polyetheretherketone cage consists of an interbody spacer and a titanium clip. The anchoring clip is placed into the lower vertebra through the anterior part of the cage after implantation to assist cage fixation.

3. Results

The mean follow-up period was 19.8 months (range = 15–27 months). The average operation time was 143 ± 21.5 min and the average blood loss during surgery was 102 ± 13.3 mL. All cages were implanted successfully. There were no device failures and no superficial or deep wound infections at the cervical incision site. After surgery, none of the patients experienced neurological deterioration.