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Clinical Study

Effect of posterior subsidence on cervical alignment after anterior cervical corpectomy and reconstruction using titanium mesh cages in degenerative cervical disease

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ABSTRACT

Subsidence after anterior cervical reconstruction using a titanium mesh cage (TMC) has been a matter of debate. The authors investigated and analyzed subsidence and its effect on clinical and radiologic parameters after cervical reconstruction using a TMC for degenerative cervical disease. Thirty consecutive patients with degenerative cervical spine disorders underwent anterior cervical corpectomy followed by reconstruction with TMC. Twenty-four patients underwent a single-level corpectomy, and six patients underwent a two-level corpectomy. Clinical outcomes were assessed using a Visual Analogue Scale (VAS), the Japanese Orthopedic Association (JOA) score and the Neck Disability Index (NDI). Fusion status, anterior and posterior subsidence of the TMC, segmental angle (SA) and cervical sagittal angle (CSA) were assessed by lateral and flexion-extension radiographs of the neck. The mean follow-up period was 27.6 months (range, 24 to 49 months). The VAS, NDI and JOA scores were all significantly improved at the last follow-up. No instances of radiolucency or motion-related pseudoarthrosis were detected on radiographic analysis, yielding a fusion rate of 100%. Subsidence occurred in 28 of 30 patients (93.3%). The average anterior subsidence of the cage was 1.4 ± 0.9 mm, and the average posterior subsidence was 2.9 ± 1.2 mm. The SA and CSA at the final follow-up were significantly increased toward a lordotic angle. Anterior cervical reconstruction using TMC and plating in patients with cervical degenerative disease provides good clinical and radiologic outcomes. Cage subsidence occurred frequently, especially at the posterior part of the cage. Despite the prominent posterior subsidence of the TMC, SA and CSA were improved on final follow-up radiographs, suggesting that posterior subsidence may contribute to cervical lordosis.

1. Introduction

Anterior cervical corpectomy is an effective procedure for decompression of the spinal cord in patients with severe canal stenosis and anterior pathologies, especially when the disease involves one or two vertebral levels [1–3]. This procedure has been employed for various cervical disorders including cervical spondylosis, trauma, tumor, deformity correction, infection and rheumatoid arthritis [1,3]. Stabilization and reconstruction after corpectomy is challenging and may be accomplished with iliac crest or fibular strut autografts or with allografts. Concerns have been raised regarding the efficacy and potential complications of each of these fusion techniques. Although autologous iliac bone grafts are considered to be an ideal fusion material with a high fusion rate, this technique has been questioned due to its donor-site harvest-related morbidities [4]. Fibula strut autografts are an alternative donor site but have been reported to be associated with stress fractures of the tibia, ankle instability and chronic pain. Allografts and bone substitutes have higher rates of nonunion than autografts and may be associated with a higher incidence of graft collapse [5–11].

Titanium mesh cages (TMC) are an alternative option that may help to avoid the complications related to graft collection and are gaining acceptance. TMC with local bone grafting from corpectomy have additional advantages including immediate anterior column stability, easy control of the cage length, good biocompatibility, reduced instrumentation-related morbidity and shorter operating times. The aim of this study was to evaluate the clinical results and effectiveness of TMC for post-corpectomy reconstruction of patients with cervical degenerative disease who underwent single or two-level anterior cervical corpectomy using TMC filled with autologous bone chips.

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2. Materials and methods

2.1. Study population

From December 2006 to April 2010, a total of 30 patients underwent anterior cervical fusion using TMC (Pyramesh; Medtronic Sofamor Danek, Memphis, TN, USA) that were filled with autologous bone chips obtained from the corpectomy site, were reviewed. Anterior cervical plates (Zephir; Medtronic Sofamor Danek, Memphis, TN, USA) were also used to stabilize the affected segments in all patients. In general, corpectomies were performed when there was evidence of disease behind the vertebral body.

The patient population included 19 men and 11 women. Their ages ranged from 24 to 78 years, with a mean age of 52.4 years. The mean follow-up period was 27.6 months (range, 24–49 months). All 30 patients requiring cervical corpectomy had degenerative disease (16 cases of spondylosis, 12 cases of ossification of the posterior longitudinal ligament and two cases of ruptured discs). Of the 30 patients, 15 presented with myelopathy, and 15 patients presented with radiculopathy. Patients with neoplastic, traumatic and infectious diseases were excluded from the study. A summary of the preoperative characteristics of the 30 patients is provided in Table 1.

2.2. Surgical procedure

Under general anesthesia, the patient was placed in the supine position with the neck slightly extended using a foam roll beneath the shoulders. No external traction was used. The cervical spine was exposed using a standard anterior right-sided approach medial to the sternocleidomastoid muscle, using a transverse incision for a single-level corpectomy and an oblique incision for two-level corpectomy. After dividing the platysma sharply at right angles to the skin incision, blunt finger dissection between the carotid sheath and esophagus was performed, thereby exposing the anterior cervical spine. Following this, the vertebral levels were identified radiographically, and the anterior longitudinal ligament was incised. An interbody pin distractor system was always used prior to performing discectomies above and below the affected site. After the adjacent discectomies, the anterior two-thirds of the vertebral body was excised using a rongeur, and the posterior third was removed using curettes and a high-speed drill. Autologous bone chips obtained from the excised vertebral body were used as the bone graft material. The posterior longitudinal ligament was excised in all patients to complete decompression of the spinal cord and exiting nerve roots. The cartilage was cleaned from the endplates of the adjacent intact vertebral bodies, which were flattened with a high-speed drill or curettes, carefully preserving most of the cortical part of the endplates. After good pulsation was observed, thereby confirming anterior protrusion of the dural theca, the distance between the intact vertebral endplates was carefully measured. An appropriate TMC was selected and cut down to fit the corpectomy defect. After trimming the titanium mesh to fit the graft site, cancellous bone chips from the excised vertebral body were morselized and packed into the cage. The TMC, packed with the autograft, was then inserted into the corpectomy defect under traction. Cancellous bone from the corpectomy was applied around the lateral and anterior convexity of the cage. Finally, an anterior cervical plate was applied to achieve anterior cervical fixation. Proper hardware placement was confirmed by intraoperative fluoroscopy. Postoperatively, all patients wore a cervical collar brace for 4–6 weeks; early ambulation was encouraged.

Table 1
Preoperative characteristics of patients with degenerative cervical spine disorders undergoing anterior cervical corpectomy and fusion

	Patients, n
Sex	
Male	19
Female	11
Age, years	
<50	11
50–60	8
>60	11
Diagnosis	
Degenerative disease	30
Spondylosis	16
OPLL	12
Ruptured HNP	2
Symptoms	
Radiculopathy	15
Myelopathy	15

HNP = herniated nucleus pulposus, OPLL = ossification of posterior longitudinal ligament.

2.3. Clinical assessment

Clinical outcomes were assessed preoperatively and at the final follow-up using the Visual Analog Scale (VAS) for arm and neck pain (0 = no symptoms, 10 = maximum pain), the Neck Disability Index (NDI) and the Japanese Orthopedic Association (JOA) score. The NDI scoring system includes scores for pain intensity, personal care, lifting, reading, headaches, concentration, work, driving, sleeping, and recreation. The maximal NDI score is 50, and a lower score represents a better clinical condition. Myelopathic symptoms were rated according to the JOA scoring system for evaluation of functional neurologic status. The JOA scoring system used assessed motor function of the upper and lower extremities, sensory function of the trunk, upper and lower extremities, and bladder function. A total score of 17 is given to normal individuals.

2.4. Radiological assessment

All patients underwent dynamic radiographs before surgery, immediately after surgery and at the final follow-up. CT scans were pe in selected patients depending on the clinical indication. The following parameters were assessed radiologically: segmental angle (SA), cervical sagittal angle (CSA) and anterior (AIBH) and posterior interbody height (PIBH). These parameters were determined based on neutral lateral radiographs taken with the patient in a standing position. The SA was defined as the angle formed between the lines drawn parallel to the cranial endplate of the most cranial vertebra and the caudal endplate of the most caudal vertebra at the fusion level (Fig. 1A). The CSA was defined as the angle formed by the lines drawn parallel to the caudal endplate of C2 and the caudal endplate of C7 (Fig. 1B). Anterior subsidence was defined as the difference in AIBH between the postoperative and final follow-up values, and posterior subsidence was defined as the difference in PIBH between the postoperative and final follow-up values. A solid fusion was diagnosed using the following radiologic parameters on lateral radiographs or CT scan: no movement or less than 2° of motion on dynamic radiographs; absence of lucency or halo around the screw or cage-bone interfaces; absence of screw back-out, plate breakage or migration; and osseous continuity through and/or around the cage and the adjacent upper and lower endplates. These measurements were performed by a single independent observer who was not involved with the surgery or care of patients.

2.5. Statistical analysis

Radiographic parameters and clinical outcomes at the last follow-up were compared with preoperative data. Data were