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Clinical Study

Clinical adjacent-segment pathology after anterior cervical discectomy and fusion: results after a minimum of 10-year follow-up

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Abstract

BACKGROUND CONTEXT: Anterior cervical discectomy and fusion using cervical plates has been seen as effective at relieving cervical radiculopathy and myelopathy symptoms. Although it is commonly used, subsequent disc degeneration at levels adjacent to the fusion remains an important problem. However, data on the frequency, impact, and predisposing factors for this pathology are still rare.

PURPOSE: To evaluate the incidence, predisposing factors, and impact of radiographic and clinical adjacent-segment pathologies after anterior cervical discectomy and fusion using cervical plates and to analyze the efficacy of this surgical method over the long term, after a minimum follow-up period of 10 years.

STUDY DESIGN: Retrospective clinical study.

PATIENT SAMPLE: Our study was a retrospective analysis of 177 patients who underwent anterior cervical discectomy and fusion using cervical plates, with follow-up periods of at least 10 years (mean 16.2 years).

OUTCOME MEASURES: Radiographic adjacent-segment pathology using plain radiographs and clinical adjacent-segment pathology after anterior cervical discectomy and fusion using cervical plates.

METHODS: We defined a new grading system of plain radiographic evidence of degenerative changes in adjacent discs after anterior cervical discectomy and fusion using cervical plates; Grade 0 is considered normal, and Grade V consists the presence of posterior osteophytes and a decrease in disc height to less than 50% of normal. The incidence, predisposing factors, and impact of radiographic and clinical adjacent-segment pathologies were analyzed according to etiologies, number of fused segments, and plate-to-disc distance.

RESULTS: Radiographic and clinical adjacent-segment pathologies were found in 92.1% and 19.2%, respectively, of patients. By etiology, clinical adjacent-segment pathology was observed in 13.5% of patients who had sustained trauma, 12.7% of those with disc herniation, and 33.3% of those with spondylosis. By number of fused segments, clinical adjacent-segment pathology was found in 13.2% of patients who underwent single-level fusion and in 32.1% of those who underwent multilevel fusion surgeries. Patients with a plate-to-disc distance of less than 5 mm, who had spondylosis, or who underwent multilevel fusion had a higher incidence of clinical adjacent-segment pathology after anterior cervical discectomy and fusion using cervical plates than other groups did ($p<.05$). Of all patients, only 6.8% needed follow-up surgery.

CONCLUSIONS: We found that over the long term, at a minimum follow-up point of 10 years, a plate-to-disc distance of less than 5 mm, having spondylosis, and undergoing multilevel fusion were predisposing factors for the occurrence of clinical adjacent-segment pathology. Nevertheless, the incidence of clinical findings of adjacent-segment pathology was much lower than the incidence of radiographic findings. Also, the rate of follow-up surgery was low. Therefore, anterior cervical

FDA device/drug status: Approved (H-shaped ASIF plate [AO synthes, Switzerland]; ACP [Codman, USA]).

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discectomy and fusion using cervical plates can be considered a safe and effective procedure.

Keywords: Cervical vertebrae; Spinal fusion; Plate; Radiography; Clinical; Adjacent-segment pathology; Follow-up surgery; Long-term follow-up

Introduction

Anterior cervical discectomy using the fusion method was first reported by Smith and Robinson [1]. This method, which is relatively safe and allows direct decompression of the spinal cord and bone union simultaneously, is one of the most commonly performed procedures for the cervical spine. In particular, fusion with cervical plates has been used widely in such settings as trauma, disc herniation, spondylosis, and tumors because of its advantages: initial stability, higher fusion rate, recovery of normal lordosis, and the lack of necessity for external support. In addition, good results with this technique have been reported in the literature. However, in spite of the procedure's success at relieving the symptoms of radiculopathy and myelopathy, subsequent development of significant disc disease at levels adjacent to fused discs is a matter of grave concern [2,3]. Clinical pathology of adjacent segments, which is defined as the development of new radiculopathy or myelopathy arising from motion of segments adjacent to the site of previous anterior cervical fusion, is a more serious problem than radiographically apparent pathology of adjacent segments. However, data on the incidence, predisposing factors, and impact of radiographically versus clinically evident adjacent-segment pathology are still rare.

The pathogenesis of this disease is still a matter of debate. It remains controversial whether the acceleration of adjacent-segment pathology is because of natural progression of the disease [4–6] or because of increased motion stress related to biomechanical factors secondary to the surgical fusion itself [2,7–11]. Knowledge of adjacent-segment pathology has led to the development of motion-preservation techniques, such as cervical disc arthroplasty, to reduce its incidence, and to a shift in surgical treatment from anterior fusion to other methods [12–14]. Therefore, adjacent-segment pathology of the cervical spine is among the most controversial topics in spinal surgery.

We conducted a study to identify the incidence, clinical impact, and predictive factors for radiographic adjacent-segment pathology, using plain radiographs after anterior cervical discectomy and fusion with cervical plates. We also analyzed the incidence and predisposing factors for clinical adjacent-segment pathology and the efficacy of anterior cervical discectomy and fusion using cervical plates over the long term, after a minimum follow-up period of 10 years.

Materials and methods

Between 1984 and 2002, we treated 416 patients at our institution with anterior cervical discectomy and fusion using cervical plates. Among those, 39 could not be contacted after surgery because of changed contact information, 20 had died because of extrasurgical problems, and 22 were contacted by telephone but were unable to come in for follow-up examinations owing to personal circumstances. Therefore, at 10 or more years after surgery, there were no follow-up plain radiographs available for 81 patients. An additional 54 patients were excluded from our study because they had undergone other cervical spine surgery previously, were younger than 40 years, and/or had an inflammatory disease. Also, 104 patients with radiographic documentation of preexisting adjacent-segment pathology were excluded. Thus, our study group included 177 patients who had been monitored for a minimum of 10 years (mean 16.2 years, range 10.0–25.2 years) after surgery: 108 men and 69 women. Their average age at the time of the initial procedure was 52.4 (range 40.8–74.3) years. Fifty-two patients were treated for trauma, 71 for disc herniation, and 54 for spondylosis. Cervical spondylosis included cervical radiculopathy or myelopathy by narrowing of the spinal canal, decreased disc height, degenerative changes of the uncovertebral joints, and vertebral osteophytosis, but not pure axial neck pain. There was no statistically significant difference in follow-up duration between etiologies. Single-level fusion was done in 121 of the 177 patients, and multilevel fusion was done in the other 56. C5–C6 cervical fusions were most frequently performed (57 patients), followed by C6–C7 (35 patients) and C5–C7 (27 patients). Autologous iliac crest graft was used in all patients. After surgery the 121 patients who underwent single-level fusion wore no cervical orthosis, and the 56 patients who underwent multilevel fusion wore a soft cervical collar for a total of 4 weeks. Bone union was checked at each subsequent examination. The criteria used to define fusion were as follows: no radiolucency between the graft and the vertebral body, the presence of bridging osseous trabeculae, and less than 1 mm of motion between the tips of the posterior spinous processes of the fused segments on flexion and extension lateral radiographs of the cervical spine.

We compared preoperative and final-examination plain radiographs, both anteroposterior and lateral, for all 177 patients and assessed degree of disc-space narrowing and anterior and posterior osteophyte formation at the superior and inferior adjacent levels. On the basis of our findings, we modified the grading system used in the previous reports [4,15,16] for radiographic evidence of adjacent-segment degeneration. We defined a new six-level grading system of radiographic evidence of degenerative changes of adjacent discs after anterior cervical