Plasmapore-Coated Titanium Cervical Cages Induce More Rapid and Complete Bone Fusion After Anterior Cervical Discectomy and Fusion as Compared to Noncoated Titanium Cages

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Key words
- Anterior cervical discectomy and fusion
- Bone fusion rates
- CT scan reconstructive sagittal section
- Plasmapore-coated cages
- Solid bone fusion

Abbreviations and Acronyms
ACDF: Anterior cervical decompression and fusion
CT: Computed tomography
N-PPC: Non—Plasmapore-coated titanium cages
PPC: Plasmapore-coated titanium cages
SBF: Intervertebral solid bone fusion

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OBJECTIVE: **The aim of this study was to examine the solid bone fusion rates between Plasmapore-coated titanium cages (PPC group) and non—Plasmapore-coated titanium cages (N-PPC group) in patients who received anterior cervical decompression and fusion (ACDF).**

METHODS: **Of 78 patients who received ACDF at the hospital, a follow-up period greater than 2 years was possible for 61 patients, including 30 in the PPC group and 42 in the N-PPC group. Evaluations were performed at 3, 6, 12, and 24 months after surgery. Radiological stabilization (RS) was defined as the restriction of spinous process movement to <3 mm and the absence of a halo around the cages on flexion-extension radiographs. Solid bone fusion (SBF) was defined as the formation of bony bridges between the fixed vertebral bodies in sagittal computed tomography sections. The rates of RS and SBF were compared between both groups.**

RESULTS: **The differences in RS were not significant between the 2 groups during the follow-up period. However, the SBF rates at 6 and 12 months were significantly higher in the PPC group (26.7% and 56.7%) than in the N-PPC group (5% and 21.4%). Moreover, 63.3% (19 of 30) of patients in the PPC group demonstrated RS at 3 months, and of these patients, SBF was observed in 100% (19 patients) after 24 months, respectively. In comparison, the SBF rates in the N-PPC group were 86%.**

CONCLUSIONS: **Plasmapore-coated titanium cages enabled more rapid solid bone fusion. We suggest that these types of cages might help to reduce post-operative radiograms.**

INTRODUCTION

Anterior cervical decompression and fusion (ACDF) was first reported as a treatment for degenerative cervical disc disease in 1958 by Smith and Robinson (17). The purpose of this manipulation is to achieve decompression of the cervical cord or the nerve root and to attain early solid stabilization at the surgical level. Autologous tricortical iliac bone has widely been used as an interbody graft (5). Although the bone fusion rate at the intervertebral space provided by this type of graft is high (between 83% and 97%) (4), some donor site problems have been reported, such as donor site pain, hematoma, and infection (3, 8, 15, 16, 21). To decrease or eliminate these complications, the first interbody fusion cages were developed by Bagby (2). Since this time, a variety of cages have been developed and used, including cylindrical (9) or rectangular (19) titanium cages, Plasmapore-coated titanium cages (PPC) (1), and polyetheretherketone cages (7), and these cages have been implemented both with and without synthetic bone grafts (18). Moreover, these cages have been reported to provide sufficient intervertebral bone fusion rates between 81% and 100%. Although Plasmapore-coated titanium implants were shown to stimulate early osteointegration and osteoconduction in an animal study (20), it remains unclear whether the implants lead to solid fusion earlier than non—Plasmapore-coated cages (N-PPC) in human study.

In the present study, solid bone fusion rates after the implementation of PPC and N-PPC, what is called orthodox titanium cages in patients receiving ACDF, were determined at several time points up to 2 years post-ACDF.

MATERIALS AND METHODS

Patient Population

This is a retrospective cohort study. From May 2006 to August 2010, ACDF with the use of 2 types of titanium box cages was performed in 78 patients who had cervical spondylosis 2-disc herniations. We retrospectively examined 72 (47 men and 25 women) patients who were followed up for more than 24 (range, 24 to 93) months after the surgery. The mean age of these patients was 58.7 (range, 33 to 81) years. Patients were included in the study if they had undergone 1 ACDF procedure using a titanium cage for symptomatic cervical

disc herniation or spondylosis. Patients with traumatic injury, infection, ossified posterior longitudinal ligaments, or more than 2 previous ACDF procedures were excluded.

Surgical Procedure

ACDF was performed at intervertebral segments. Non–Plasmapore-coated M-cages SR (Ammtec, Tokyo, Japan) were used in 42 patients from May 2006 to August 2009 (N-PPC group), and CESPACE cages coated with Plasmapore (B.Braun AESCULAP, Tokyo, Japan) were used in 30 patients from September 2009 to August 2010 (PPC group). Both cages were similar in terms of size and box shape. Discectomy was performed with complete preservation of the bony endplate on both the upper and lower intervertebral surfaces. The posterior longitudinal ligaments and posterior osteophytes were removed until release of the dural sac and nerve roots from the compression was observed. Neither type of box cage was inserted into the empty interbody space, and anterior plating was not placed. All cages were unpacked, i.e., they did not include autologous grafts, allografts, or synthetic bone grafts, and all patients were instructed to wear a soft cervical collar for 6 to 8 weeks after the surgery.

Radiological Evaluation

Intervertebral radiological stabilization was defined using Ray's criteria as a measurement of <3 mm between the spinous processes and the absence of a visible halo around the cages on flexion-extension radiographs (13) (**Figures 1A, 1B**). In addition, when bony bridging appeared either on anterior or posterior vertebral body aspects between fixed vertebral bodies on sagittal sections of computed tomography (CT) scans, intervertebral solid bone fusion (SBF) was achieved as defined by McAfee et al. (11) (**Figure 1C**). The evaluations were performed at 3, 6, 12, and 24 months after surgery by 2 independent observers.

Statistical Analysis

The results are expressed as mean ± SD. The Kruskal-Wallis test or *t* test was used for the evaluation of clinical outcomes, and the χ^2 test was used for the evaluation of bone fusion. Statistical data were processed using SPSS software (version 16, Chicago, IL). A value of $P < .05$ was considered statistically significant in all cases.

Study Approval, Informed Consent, and Funding

The study was approved by the institutional review board of the Aichi Medical University Hospital. The study did not receive any external funding, and the authors do not have any disclosures to declare.

RESULTS

Clinical Outcomes

There were no significant differences in sex, age, blood loss, or operation times between the PPC group and the N-PPC group (**Table 1**). No patient experienced cage migration, infection, or complications related to the surgery during the perioperative period.

Radiological Outcomes

Intervertebral radiological stabilization at the operative level was observed in flexion-extension radiographs in 63.3%, 73.7%, 83.3%, and 90.0% of patients in the PPC group and in 50.0%, 61.9%, 73.8%, and 90.5% of patients in the N-PPC group at

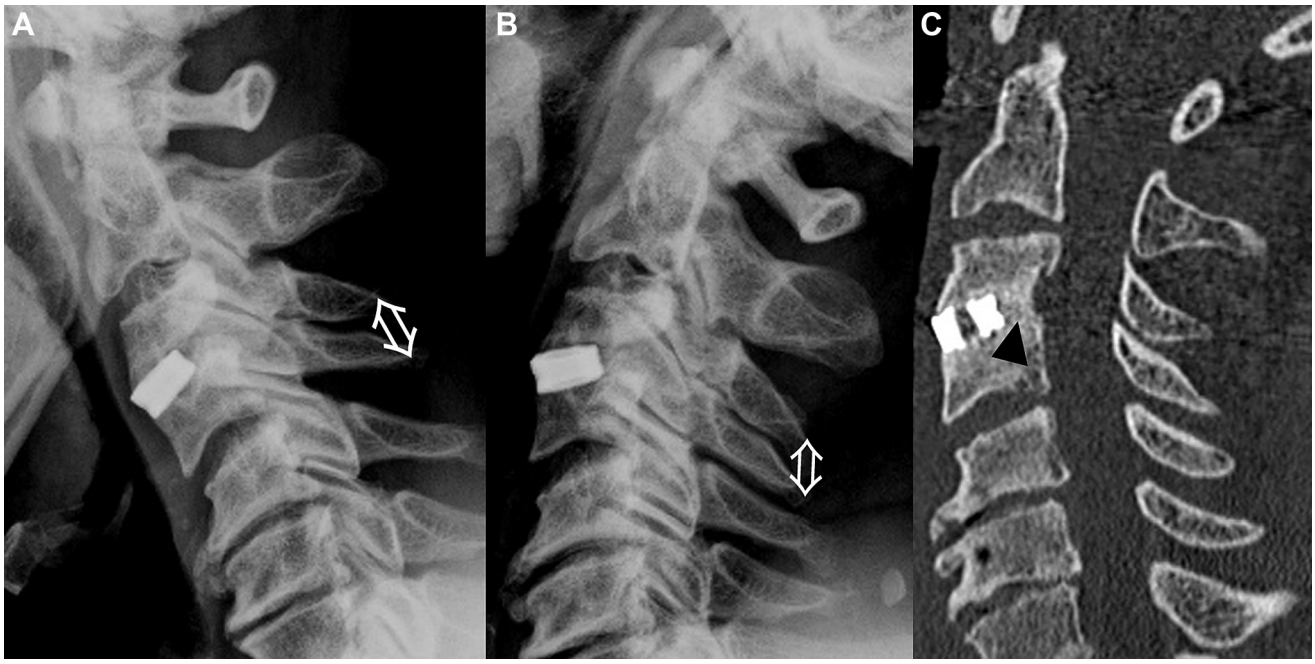

Figure 1. Radiological stabilization, as indicated by an interval of <3 mm at the tip of spinous processes according to postoperative dynamic flexion (**A**) and extension (**B**) radiographs. (**C**) Solid bone fusion, as indicated by a bony bridge *(arrowhead)* at the reconstructive site on the sagittal sections of computed tomography scans.