ORIGINAL ARTICLE

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Effects of anti-osteoporosis treatment in the elderly with anterior cervical discectomy and fusion

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Objective: The aim of this study was to evaluate the effect of anti-osteoporosis treatment on radiological and functional results following anterior cervical discectomy and fusion (ACDF).

Methods: Medical records of 59 patients (Mean age 68.1 years, 36 males and 23 females) who had ACDF surgery between January 2010 and December 2013 were retrospectively reviewed. Antiosteoporotic treatment group consisted of 31 patients and non-antiosteoporotic treatment group consisted of 28 patients. The height of intervertebral space (HIS), cervical alignment (CA), segmental angle (SA), and Visual Analogue Scale (VAS) were compared between the groups, preoperatively, postoperatively, and at final follow-up.

Results: There were significant differences at final follow-up between the 2 groups in SA (p=0.03), HIS (p=0.03), and VAS (p=0.03) for upper limb pain, in favor of antiosteoporotic treatment.

Conclusion: Anti-osteoporotic treatment appear to improve the radiological and functional results following following anterior cervical discectomy and fusion.

Keywords: Anterior cervical discectomy and fusion; elderly patients; osteoporosis; retrospective study.

Level of Evidence: Level IV, Therapeutic study.

An anterior cervical approach is frequent in spinal surgery. Anterior cervical discectomy and fusion (ACDF) has excellent clinical outcomes and is relatively safe; thus, it has become the most common procedure for degenerative spinal cervical disease. More than 5 million ACDF operations were conducted in the United States between 1990 and 1999.[1] ACDF is beneficial in the treatment of radiculopathy because it has less morbidity than laminectomy, can remove disc pathology without disturbing the spinal canal, and allows interbody fusion of the cervical spine at the specific intervertebral level from which symptoms arise.

Osteoporosis is a condition in which bone strength is compromised due to deterioration in bone mass and quality.[2–5] It is a chronic disease with increasing global incidence and is frequently associated with fragility fractures.[6,7] In the United States, roughly 2 million osteoporotic fractures occur each year. This number is of great concern, considering that those who sustain such fractures have a 3- to 4-fold increased chance of having

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a future fracture.[8,9] In fact, future fracture risk in the elderly may increase by up to 9.5-fold.[10]

There have been many reports on treatment outcomes of patients with degenerative spinal cervical disease.[11,12] However, few reports have described treatment outcomes of osteoporosis patients with degenerative spinal cervical disease. The purpose of this retrospective study, conducted from January 2010 to December 2013, was to analyze outcomes of anti-osteoporosis treatment of patients with cervical spondylotic radiculopathy and osteoporosis.

Patients and methods

Medical records of patients with ACDF who were treated at our institution from January 2010 to December 2013 were retrospectively reviewed. The patients enrolled met the following criteria: 1) age >60 years; 2) diagnosis of degenerative spinal cervical disease and treated by ACDF; 3) tested by dual energy X-ray absorptiometry and T-score <−2.5; 4) operative level was single level at C3–C4, C4–C5, C5–C6, and C6–C7; and 5) follow-up period >12 months. Exclusion criteria included glucocorticoids-induced osteoporosis, multilevel cervical spinal stenosis, trauma, infection, and history of cervical spine surgery. Patients were divided into 2 groups: anti-osteoporosis treatment group (Group A) and non-anti-osteoporosis treatment group (Group B). Operations were performed by 2 senior surgeons, who had agreed on a treatment plan.

ACDF surgery was performed with a routine procedure using tricortical autografts. Bone mineral density was tested by dual energy X-ray absorptiometry. The diagnosis was based on T-score and g/cm2 values. T<−2.5 was defined as osteoporosis. Anti-osteoporotic treatment included oral activated vitamin D 800 IU/day, calcium 1200 mg/day, and diphosphonate. All patients were treated with the same dose after undergoing ACDF. Serum calcium was checked once a month. Anti-osteoporotic drug administration was confirmed by patients until final follow-up.

The medical records and follow-up data of the study population were reviewed. The study parameters were recorded preoperatively and at 1, 3, 6, 9, and 12 months postoperatively. Bone fusion was assessed according to the criteria defined by Lee et al.[13] The height of intervertebral space (HIS) was measured on a lateral radiograph and defined as the distance from the highest portion of the lower endplate in the cephalad vertebra to the closest portion of the upper endplate in the caudal vertebra (Figure 1a, b). Subsidence is defined as a greater than 2-mm reduction in disc height due to implant migration into adjacent endplates.

Cervical alignment (CA) was defined by the Cobb angle formed between the upper vertebral body of C3 and the lower vertebral body of C7 (Figure 1c, d). The segmental angle (SA) was defined as the Cobb angle of the vertebral bodies adjacent to the involved disc (Figure 1e, f). Radiological evaluations were conducted, and neck and arm pain were measured using visual analog scale (VAS) before surgery, immediately after surgery, and at final follow-up visit.

Fig. 1. **(a, b)** Measurement of intervertebral distance. Length between the center of the superior endplate of upper vertebral body and the inferior endplate of lower vertebral body was measured. **(c, d)** Measurement of cervical alignment. The Cobb angle formed between the upper vertebral body of C3 and the lower vertebral body of C7. **(e, f)** Measurement of segmental angle. The Cobb angle of the vertebral bodies adjacent to the involved disc was measured.

Variables between the A and B groups were compared using independent t-test, Mann-Whitney U test, and χ^2 test. The radiological and clinical outcomes prior to surgery, immediately after surgery, and at final follow-up visit were compared using paired t-test and Wilcoxon signed-rank test. A p value of <0.05 was considered statistically significant. Statistical analyses were performed using SPSS software (version 11.0, SPSS Inc., Chicago, IL, USA).

Results

Fifty-nine patients were enrolled in this study, consisting of 31 patients in Group A and 28 in Group B. There were no significant differences in patients' characteristics (Table 1). Bone mineral density (g/cm^2) was significantly different between the 2 groups at final follow-up (Table 1). No differences were found in CA preoperatively, postoperatively, and at final follow-up; nor were there any

Table 1. Characteristics of patients with anterior cervical discectomy and fusion.

	Group A (n=31)	Group B (n=28)	Total (n=59)	p
Age (years)	69.02±6.33	67.38±4.95	68.07±5.98	0.268
Sex				0.964
Male	19	17	36	
Female	12	11	23	
Operation level				
C3–C4	2	1	3	
C4–C5	5	4	9	
C5–C6	18	17	35	
C6–C7	6	6	12	0.956
T-score				
Preoperatively	-2.88±-0.75	-2.79±-0.81	-2.90±-0.86	0.584
Final follow-up	-2.77±-0.68	-2.68±0.79	-2.81±-0.83	0.470
Serum calcium				
Preoperatively	2.25±0.08	2.31±0.09	2.28±0.08	-0.337
Final follow-up	2.31±0.11	2.30±0.09	2.30±0.10	0.380
Bone mineral density (g/cm^2)				
Preoperatively	0.734±0.218	0.758±0.237	0.741±0.221	0.687
Final follow-up	0.807±0.258	0.685±0.178	0.788±0.247	0.041
Smoking				
Yes	11	12	23	
No	20	16	36	0.562
Follow-up period (mo)	8.3±1.9	8.8±2.1	8.15±2.2	0.958

Table 2. Comparison of cervical alignment, segmental angle, and height of intervertebral space values preoperatively, postoperatively, and at final follow-up.

	Group A (n=31)	Group B (n=28)	p
	Mean±SD	Mean±SD	
Cervical alignment (°)			
Preoperatively	-0.87±1.01	-0.91±1.07	0.883
Postoperatively	1.57±1.39	1.39±1.41	0.624
Final follow-up	1.48±1.27	1.31±1.37	0.623
Segmental angle (°)			
Preoperatively	-1.85±1.33	-1.92±1.59	0.855
Postoperatively	6.88±2.07	6.41±1.84	0.363
Final follow-up*	6.58±2.11	5.33±2.17	0.029
Height of intervertebral space (mm)			
Preoperatively	3.07±1.39	3.21±1.57	0.718
Postoperatively	8.97±2.37	9.12±2.57	0.816
Final follow-up*	8.89±2.21	7.88±1.02	0.031

*Negative sign indicates kyphosis in the segmental values. SD: Standard deviation.

Table 3. Comparison of Visual analog scale and neck disability index scores preoperatively, postoperatively, and at final follow-up.

	Group A (n=31)	Group B (n=28)	p
	Mean±SD	Mean±SD	
Visual analog scale for neck pain			
Preoperatively	7.2±1.8	7.3±1.5	0.819
Postoperatively	2.7±0.9	2.5±1.0	0.422
Final follow-up	1.2±0.3	1.3±0.5	0.350
Visual analog scale for upper limb pain			
Preoperatively	6.9±1.1	7.0±1.3	0.750
Postoperatively	2.5±0.8	2.7±0.9	0.370
Final follow-up*	0.9±0.3	1.1±0.4	0.033
Neck disability index			
Preoperatively	16.8±5.8	17.7±6.1	0.564
Postoperatively	8.5±2.1	8.8±3.2	0.669
Final follow-up	3.7±1.1	4.1±1.8	0.302

SD: Standard deviation.

differences in SA and HIS preoperatively and postoperatively (Table 2). However, there were significant differences in SA and HIS at final follow-up. There was a significant difference in VAS score for upper-limb pain at final follow-up between Group A and Group B, though there was no difference preoperatively and postoperatively. There was no significant difference between the 2 groups in VAS score for neck pain at any visit (Table 3). Neck disability index results showed that patients in the anti-osteoporosis treatment group improved more than patients in the non-anti-osteoporosis treatment group after surgery; however, this difference was not statistically significant. All patients met the treatment objectives with no different subjective sensation of upper limb. No complications or mortality occurred. No nerve function deteriorated. All patients achieved satisfactory graft union for a mean period of 8.8 months (range: 6–11 months).

Discussion

Over the past 50 years, ACDF has become a well-established and routine procedure for symptomatic degenerative cervical disc disease.[14] It relieves neural compression and improves spinal stability by fusion of the affected segments. Data from the present study indicates that factors such as osteoporosis could be important for the outcome of ACDF.

Osteoporosis is a challenge for physicians due to the increasing elderly population. Especially in China, fragile fracture associated with osteoporosis—such as hip, radius and humerus— is becoming increasingly common. However, if the site of osteoporosis occurs at the spine and is accompanied with degenerative spinal disease, treatment can be difficult. Although anti-osteoporosis treatment is effective in preventing the progression of osteoporosis, the benefit of this treatment for the postoperative management of degenerative spinal disease is unclear. Lin et al. reported that patients with osteoporosis were more likely to develop new fractures following vertebroplasty, many of which occurred in vertebrae adjacent to those previously treated.[15] Babat et al. demonstrated in a rabbit model that there is no evidence to support a recommendation to stop anti-osteoporosis therapy for patients who have undergone spinal fusion surgery.[16]

According to previous studies,[17] the main factors affecting subsidence are CA, age, and use of plates after ACDF. Surgeons should consider patients' kyphotic curvature and/or age when deciding on the use of plates. Buerba[18] found that older age is an independent risk factor for greater morbidity and longer hospitalizations after ACDF, even after adjustment for comorbidities, when compared to younger patients. Surgeons should be aware of the increased risk of multiple complications for patients of advanced age in their surgical decision-making process. In another study,[19] the increase in intervertebral space or interfacet distance following the insertion of a large graft material while performing ACDF for the treatment of degenerative cervical disease was not related to the change in VAS score for neck and arm pain. Data from this study showed that anti-osteoporosis treatment could benefit the outcome of ACDF in osteoporotic patients.

According to Fu's study,[20] preoperative serum hypoalbuminemia was an important adjunct predictor of major complications following ACDF. In high-risk patients with multiple medical comorbidities, we recommend that clinicians consider nutritional screening and optimization as part of preoperative risk assessment. In the present study, although patients' nutritional status was

not taken into account, no patients experienced complications. The 2 surgeons had agreed on the surgical plan after considering many other patient factors and therefore had a detailed understanding of the patients' status preoperatively.

Limitations of this study are its single-center retrospective nature and the small number of patients. Moreover, the strategy for choosing an optimal procedure is based on the retrospective analysis. A long-term follow-up of a prospective cohort is needed in the future to confirm the present results and evaluate the selection criteria.

Conclusion

Anti-osteoporosis treatment is necessary for elderly patients aged over 60 with degenerative spinal cervical disease.

Conflicts of Interest: No conflicts declared.

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