Long-term follow-up radiologic and clinical evaluation of cylindrical cage for anterior interbody fusion in degenerative cervical disc disease

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Introduction

Various procedures have been introduced for anterior interbody fusion in degenerative cervical disc disease including plate systems with autologous iliac bone, carbon cages, and cylindrical cages. However, except for plate systems, the long-term results of other methods have not been established. In the present study, we evaluated radiologic findings for cylindrical cervical cages over long-term follow up periods.

Methods

Patient selection

From 2003 to 2006, anterior interbody fusion with a cylindrical cage (AMSLUTM cage, Eurosurgical, Amsterdam, The Netherlands) was performed in 138 patients (Figure 1). Among these patients, a total of 99 were followed-up for more than 36 months and were retrospectively enrolled in the present study through reviews of medical charts, operative notes, and radiologic images.

Radiologic assessment

Plain radiographs including anterior-posterior views and lateral views including neutral, flexion, and extension were obtained during the preoperative period, immediately after surgery, 6 months, 12 months, 24 months, and at least 36 months after surgery.

At each follow-up, we evaluated radiographs for bony fusion, subsidence, kyphotic angle from cage direction change, osteophyte formation of anterior and posterior portion, and surgical complications.For the evaluation of cage subsidence, intervertebral disc height was measured by dividing of the sum of the three points including the anterior, posterior, and midpoint interbody distance by 3. Subsidence was defined as any settlement in disc height of at least 3 mm on lateral radiographs. We defined bony fusion as occurring when segmental motion was not noted in dynamic radiographs and there was no radiolucency around the cage.

Results

Cylindrical titanium cage

Osteophyte grade

Grade	Description
0	Osteophyte formation (-).
I	Osteophyte formation (+), did not reach the disc space.
II	Osteophyte formation (+), reached the disc space (upper or lower level).
III	Osteophyte formation (+), reached the disc space (upper and lower levels) without bridge formation.
IV	Osteophyte formation (+), with bridge formation.

Demographics of enrolled patients

	Number
Study period	Jan. 2003 - Dec. 2006
Total patients (levels)	96 (112)
Mean age (range)	48.4 years (29-72)
Male : Female	51 : 45
Mean follow-up period	38.61 months (range, 36-68)
Level	
Single level	80 patients
C34	2
C45	9
C56	50
C67	19
Two level	16 patients
C34/C45	1
C45/C56	5
C56/C67	10
Bone fusion rate	100%

Statistical analysis of subsidence related sex and level*

		Absence	Presence	*p* value
		Number (%)	Number (%)	
Sex	Male	9 (50)	42 (53.8)	0.768
	Female	9 (50)	36 (46.2)	
Level	C34	1 (5.6)	2 (2.6)	0.361
	C45	2 (11.1)	12 (15.4)	
	C56	9 (50)	51 (65.4)	
	C67	6 (33.3)	13 (16.7)	

Statistical analysis by Spearman's coefficient correlation and phi correlation in all enrolled patients

	Mean	Subsidence		Osteophyte_anterior		Osteophyte_posterior	
		r	p	r	p	r	p
Age	48.4	0.14	0.171	0.23	**0.022**	0.19	0.063
Sex		-0.03	0.768	-0.03	0.794	-0.10	0.314
T-score	-0.45	-0.21	**0.039**	-0.17	0.089	-0.20	0.051
VAS_preop	7.94	016	0.110	-0.01	0.890	-0.08	0.411
VAS_immed	3.31	0.11	0.288	0.00	0.972	0.10	0.325
VAS_6 mo	1.98	0.10	0.347	0.13	0.192	0.16	0.114
VAS_12 mo	1.42	0.09	0.383	0.17	0.094	0.28	**0.007**
VAS_24 mo	1.30	0.05	0.609	0.15	0.135	0.26	**0.011**
VAS_final	1.23	0.06	0.551	0.18	0.073	0.26	**0.011**
Outcome		0.1	0.871	0.2	0.061	0.3	**0.009**

Statistical analysis by Spearman's coefficient correlation and phi correlation in patients with one level surgery

	Mean	Subsidence		Osteophyte_anterior		Osteophyte_posterior	
		r	p	r	p	r	p
Age	48.43	0.12	0.295	0.21	0.062	0.15	0.193
Sex		-0.07	0.533	-0.07	0.520	-0.13	0.251
T-score	-0.42	-0.19	0.098	-0.20	0.071	-0.21	0.059
VAS_preop	7.9	0.20	0.080	-0.03	0.780	-0.09	0.424
VAS_immed	3.36	0.11	0.331	-0.01	0.937	0.08	0.497
VAS_6 mo	2.07	0.10	0.371	0.16	0.161	0.21	0.063
VAS_12 mo	1.52	0.10	0.369	0.19	0.094	0.32	**0.004**
VAS_24 mo	1.35	0.06	0.572	0.13	0.257	0.28	**0.013**
VAS_final	1.33	0.07	0.529	0.18	0.120	0.32	**0.003**
Outcome		0.1	0.861	0.2	0.102	0.3	**0.002**

Statistical analysis by Spearman's coefficient correlation and phi correlation in patients with two level surgery

	Mean	Subsidence		Osteophyte_anterior		Osteophyte_posterior	
		r	p	r	p	r	p
Age	48.70	0.36	0.165	0.35	0.178	0.35	0.187
Sex		0.26	0.302	0.23	0.381	0.00	1.000
T-score	-0.58	-0.42	0.104	-0.17	0.536	-0.24	0.373
VAS_preop	8.23	-0.14	0.597	0.03	0.901	-0.12	0.653
VAS_immed	3	0.24	0.367	0.19	0.491	0.32	0.229
VAS_6 mo	1.53	0.35	0.188	0.08	0.767	0.03	0.907
VAS_12 mo	0.88	0.30	0.257	0.15	0.571	0.19	0.474
VAS_24 mo	1.05	0.00	1.000	0.35	0.183	0.15	0.578
VAS_final	0.70	0.28	0.288	0.37	0.153	-0.01	0.977
Outcome		0.3	0.504	0.4	0.153	0.0	0.977

Statistical analysis of subsidence related factors

	Absence	Presence	*p* value
Age	45.4 ± 8.85	49.1 ± 9.07	0.17
T-score	-0.1 ± 0.72	-0.5 ± 0.94	**0.04**
VAS_preop	7.4 ± 1.61	8.1 ± 1.44	0.11
VAS_immed	3.0 ± 1.50	3.4 ± 1.51	0.285
VAS_6 mo	1.7 ± 1.08	2.1 ± 1.47	0.345
VAS_12 mo	1.2 ± 1.31	1.5 ± 1.34	0.381
VAS_24 mo	1.1 ± 1.13	1.3 ± 1.38	0.606
VAS_final	1.1 ± 1.21	1.3 ± 1.40	0.548

Conclusions

The present study describes the long term (at least 36 months) follow-up results of cylindrical cage treatment according to radiologic characteristics including subsidence, osteophyte formation, and kyphosis in a large study sample. Cage subsidence and osteophyte formation were present in almost all of the cases in our sample, which is inconsistent with the findings of previous reports. Surgeons should explain the possibility that neurologic outcomes may be aggravated by posterior osteophyte formation in late stages to patients during preoperative preparation. Cylindrical cages are relatively safe when used in patients with normal BMD, with a possibility of subsidence and kyphosis during bone fusion in patients with low T-scores, although there are low risks of severe neurologic aggravation.