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Age-Related Incidences of Spondylosis of the Lower Cervical Spine Radiographic Study of 460 Jeju Islanders

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Abstract

Study design: Cervical spine radiograms of 460 Jeju islanders, taken at the Cheju Halla General Hospital, Jeju, were the study materials.

Objectives: To investigate the age-matched incidences and severity of the cervical disc degeneration and associated pathologic findings.

Summary of background data: There exist several previous studies on the incidences of disc and Luschka's and facet joint degeneration in the Europeans and Asians which provided the basic data for the interested clinicians.

Methods: Cervical radiographs of 460 (220 males and 240 females) patients of fourth to ninth decade were subjected to this prospective study. Ninety patients of third decade were excluded because none showed the spondylotic findings on radiograms. There were 76 patients (16.5%) in fourth decade, 107 patients (23.3%) in fifth decade, 112 patients (24.3%) in sixth decade, 85 patients (18.5%) in seventh decade, 64 patients (13.9%) in eighth decade, and 16 patients (3.5%) in ninth decade.

Results: Overall incidences of cervical spondylosis were 47.8% (220 patients out of 460 patients). The percentile incidences of spondylosis in fourth, fifth, sixth, seventh, eighth and ninth decade were 13.2%(10 out of 76 patients), 34.6%(37 out of 107 patients), 58.9%(66 out of 112 patients), 58.8%(50 out of 85 patients), 70.3% (45 out of 64 patients), and 75.0%(12 out of 16 patients).

The percentile incidences of one, two, three, four and five level spondylosis among 220 spondylosis patients were 45.5%(100 patients), 34.1%(75 patients), 15.0%(33 patients), 4.5%(10 patients), and 0.9%(2 patients).

Severity of disc degeneration ranged from ± to ++++; ± in 6.0% (24 segments), + in 49.6% (198 segments), ++ in 35.3% (141 segments), +++ in 9.0% (36 segments) and ++++ in 0.25% (1 segment). Spurs and anterior ligament ossicle formed at the spondylotic segments, mostly at C4~6. Posterior corporal spurs formed in quite low rates. Olisthesis and OPLL rarely combined with spondylosis.

Cervical sagittal lordotic curve decreased gradually according to the progress of spondylosis, particularly over + disc degeneration.

Conclusion: It was evidently shown that the incidences of cervical spondylosis and numbers of spondylotic segments increased, and that degeneration became more severe gradually throughout the aging process.

Keywords: Spondylosis; Cervical; Incidences; Severity; Degenerative; Spurs

Introduction

It is known that the senescent cervical spondylosis is a generalized natural aging process affecting all levels, and that it encompasses a sequence of degenerative change in the spinal structure. That is, spondylosis is the degenerative disease of both the disk and zygapophyseal joints. It makes disk and neural foramina narrowed and forms osteophyte, and finally can lead to ligamental instability [1-6].

The first manifestation of aging in the spinal column is reflected through the intervertebral disk, "spondylosis", in the third through fifth decade. Cervical spondylosis is essentially a degenerative disorder starting in the disk and progressing with advancement in age to involve more than one disk. This disorder is common in Korea as elsewhere [1-4,7-9].

Moon et al. studied the simple radiographs of 107 aged Koreans' cervical spines to detect the spondylosis in Seoul in 1973 [10], cervical neural canal dimension measurement in 1977 [11], and Pavlov ratio in 1989. However, unfortunately, those data were not well recognized and were not clinically utilized widely even by the Korean spine surgeons [10-15].

In 19th century already Key [1] and Gowers [2] clearly described bars and ridges arising from the intervertebral area projecting backward (posterior corporal spurs) narrowing the spinal canal as a potential cause of spinal cord compression. Nowadays, it is evidently known that it relates more deeply with the clinical symptoms, particularly neurologic ones. According to Pallis et al's in 1954 [7] and Payne and Spillane's reports in 1957 [8], cervical spondylosis was common in elderly people. They found 50% of people over 50 years and 75% over 65 years had typical radiologic changes of cervical spondylosis. 40% of people over 50 years had some limitation of neck movement, and some had neurologic abnormality which often preceded symptoms [8]. Friedenberg and Miller in 1963 reported that 75% of the subject in the 7th decade displayed some degenerative changes in the cervical spine [5].

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In 1969 in England, Lawrence reviewed cervical spine x-rays of 1803 males and 1572 females, aged 15 years and over. They represented 86% and 85% respectively, of groups in a population survey. 42% of males and 37% of females had definite evidences of disc degeneration of cervical spine, but this was minimal in 21% and 24% of subjects, respectively [16]. According to his report cervical disc degeneration was related to neck-shoulder brachial pain in both sexes, but significant only in those with moderate or severe disease and narrowed discs. Degeneration was mainly related to a past episode of pain or repeated episode of pain. A history or signs of nerve root involvement was found only in 1.7% of 662 subjects with moderate to severe cervical disc degeneration. Obvious symptoms and signs of cervical myelopathy were not found [16].

Hayashi et al in 1985, found that spondylotic changes such as narrowing of the disk and osteophytes predominated at the lower disk levels such as C5-6 and C6-7 where the range of motion decreased with advancing age, and that conversely the upper disc levels such as C3-4 and C4-5 showed a comparatively greater mobility and vertebral "olisthesis", particularly "retrolisthesis" in extension. Based on the above mentioned information this prospective study was designed.

Materials and Methods

Materials

In this prospective study simple cervical radiograms of 460 adult patients (220 males and 240 females) from fourth decade up to 9th decade during July 2013 to May 2015 were the subject materials. All materials were obtained at Cheju Halla General Hospital, Jeju. Among those patients 76 patients (16.5%) were in fourth decade, 107 patients (23.3%) in fifth decade, 112 patients (24.3%) in sixth decade, 85 patients (18.5%) in seventh decade, 64 patients (13.9%) in eighth decade, and 16 patients (3.5%) in ninth decade. The cases of diffuse idiopathic cervical hyperostosis, and congenital synostosis and stenosis were excluded from the current study. There were no healthy volunteers.

Methods

The age- and gender-matched incidences of cervical spondylosis and its severity on radiograms were sought. Various radiographic findings such as reduction of disc space, anterior and posterolateral spurs, anterior ligament ossicle, end-plate sclerosis adjacent to degenerative disc, abnormalities of neurocentral and zygoapophysial joints, and relationship between disc space narrowing and osteophyte and ossicle in anterior ligament were observed.

Simple cervical radiograms were taken in four directions (anteroposterior, lateral, and both oblique views). To reduce the misinterpretation rate, and to prove the reading accuracy CT and/or MRI were taken when those images are essentially needed, and also for those who were the surgical candidates. But MRI classification of disc degeneration was not designed in this study. Gene polymorphisms for spurs were not studied.

Various image findings indicating the disc degeneration such as disc space narrowing, corporal edge spurs, ossicle in anterior corporal ligament, olisthesis, and sagittal alignment of cervical spine were observed.

Disc space narrowing in all segments was expressed by its severity in 5 grades ; Less than 20% disc height loss by ±, loss between 21 to 40% by +, loss between 41 – 60% by ++, loss between 61 to 80% by +++ and 81 to 100% loss by ++++.

Formed spurs were classified by its origin and shape; 1. Sharp anterior inferior corporal edge spur (uncinate), 2. Claw spur (paired and unpaired), and 3. Traction spur. However, to simplify the presentation the numbers of all types of spurs were summed up as a type. Anterior ligament ossicle and OALL (ossification of anterior longitudinal ligament) formed at the disc level were observed, and their role for the disc collapse was assessed. Olisthesis and OPLL were also observed.

Results

Incidences of spondylosis

Overall percentile incidences of spondylosis with various severity among the 460 adult patients over fourth decade were 47.8% (220 patients). The percentile incidences of spondylosis in fourth, fifth, sixth, seventh, eighth and ninth were 13.2% (10 out of 76 patients), 34.6% (37 out of 107 patients), 58.9% (66 out of 112 patients), 58.8% (50 out of 85 patients), 70.3% (45 out of 64 patients) and 75.0% (12 out of 16 patients) (Table 1 and Figures 1-7).

The average overall incidences of mono-, bi-, tri-, quadri-, penta-segment spondylosis were 45.5% (100 patients), 34.1% (75 patients), 15.0% (33 patients); 4.5% (10 patients), 0.9% (2 patients) out of 220 patients with spondylosis (Table 2 and Figure 2).

Material / Age (Decade)	Material numbers (Subject patients) (Male/Female)	Patient number with disc degeneration (percentile incidence)
4th	76 (16.5%)	10(13.2%)
	52M(68.4%)/24F(31.6%)	8M(80.0%) /2F(20.0%)
5th	107(23.3%)	37(34.6%)
	49M(45.8%)/58F(54.2%)	19M(51.4%)/18F(48.6%)
6th	112(24.3%)	66(58.9%)
	57M(50.9%)/55F(49.1%)	36M(54.5%)/30F(45.5%)
7th	85(18.5%)	50(58.8%)
	35M(41.2%)/50F(58.8%)	24M(48.0%)/26F(52.0%)
8th	64(13.9%)	45(70.3%)
	21M(32.8%)/43F(67.2%)	16M(35.6%)/29F(64.4%)
9th	16(3.5%)	12(75.0%)
	6M(37.5%)/10F(62.5%)	5M(41.7%)/7F(58.3%)
Total	460	220 (47.8%)
	220 males (47.8%) 240 females (52.2%)	108 males (49.1%) – 108 out of 220 112 females (46.7%) – 112 out of 240

Table 1: Age-matched radiographic incidences of cervical disc degeneration (n: 460 patients).

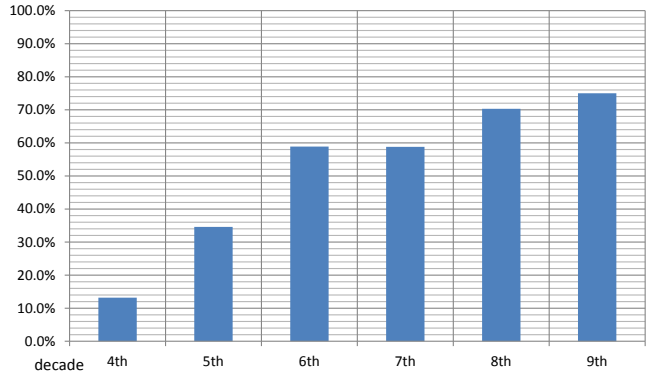

Figure 1: Histograms of age-matched percentile incidences of spondylosis in 220 patients with cervical spondylosis.

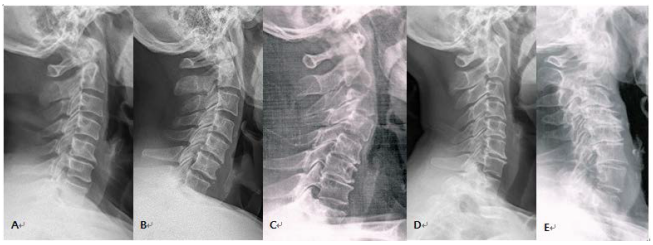

Figure 2: Lateral cervical radiograms show the different severity of disc degeneration and changes of sagittal curves, and indicates the numbers of the spondylotic segments (single to multiple); spondylosis of one segment (A), two (B), three (C), four (D), and five (E) segments.

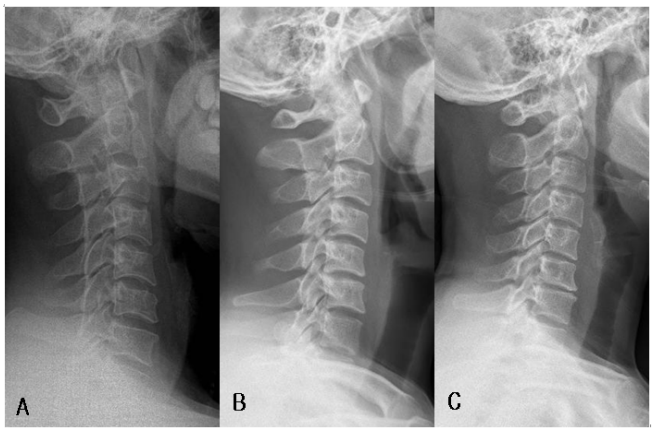

Figure 3: (4th decade patients): (A): Cervical spine with normal disc space in spite of flattened curve.
(B): Slightly flattened curve with slightly narrowed disc spaces (C_{4-5} and C_{5-6}) without anterior corporal spurs. **(C):** Flattened curve with multiple narrowed disc spaces (C_{3-7}) with early small corporal edge spurs (C_{5-6} and C_{6-7}).

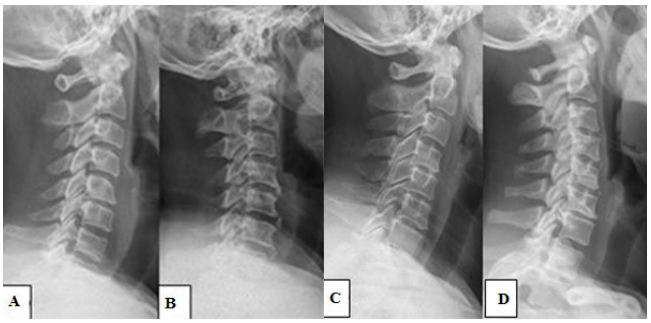

Figure 4: (5th decade patients): (A): Cervical radiogram show narrowed C_{5-6} disc space with slight curve flattening and projected anteroinferior cortical edge. (B): Well-maintained disc height with traction spurs and ossified anterior ligament (C_{2-3}, C_{4-5}, C_{5-6}). (C): Flattened cervical curve with narrow discs of C_{4-5}, C_{5-6}, and C_{6-7} without spurs. (D) : Paired small anterior spurs with slightly narrowed disc spaces at C_{4-5} and C_{5-6}.

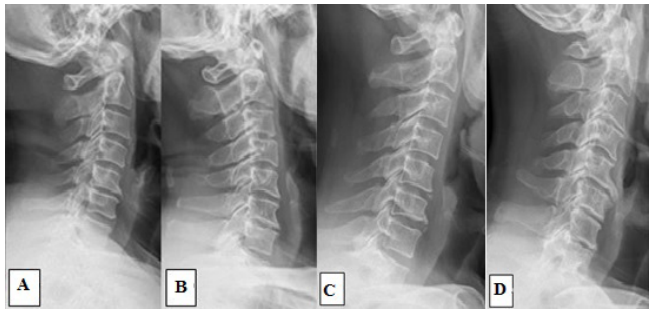

Figure 5: (6th decade) (A): Moderately advanced disc degeneration with narrowing and claw spur at C_{5-6}. (B): Slightly collapsed disc height at C_{5-6} and C_{6-7} with small claw spurs and flattened curve. (C): Flattened curve with dotted ossification of anterior corporal ligament at two levels (C_{5-6} and C_{6-7}) without disc collapse. (D): Multilevel disc degeneration with collapse and small anterior spurs (C_{3-4}, C_{4-5}, C_{5-6}, C_{6-7}, C_7-T_1).

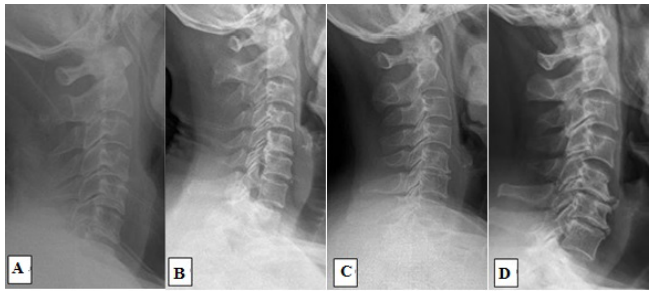

Figure 6: (7th decade): (A): C_{5-6} monosegment disc narrowing is seen. (B): Mild C_{5-6} disc collapse with visible posterior corporal spurs is seen which made the transverse corporal bony bar. (C): Marked disc collapse at C_{5-6} with claw spurs is seen. (D): Advanced disc degeneration at two levels (C_{5-6} and C_{6-7}) with large anterior traction spurs and posterior transverse corporal bony spurs is seen.

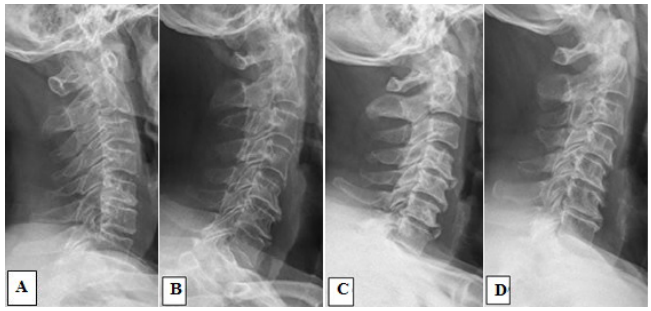

Figure 7: (8th decade) (A): Disc collapse at C_{5-6} without spurs. (B): Disc collapse at C_{5-6} and C_{6-7} with dotted ossification of anterior corporal ligament at three levels(C_{4-5}, C_{5-6} and C_{6-7}). (C): Moderate disc degeneration and collapse with anterior and posterior traction spurs are seen. (D): Loss of lordosis due to disc collapse at three levels(C_{4-5}, C_{5-6} and C_{6-7}) is seen.

The incidences of mono-segment spondylosis in 4th, 5th, 6th, 7th, 8th and 9th were 60.0% (6 out of 10 spondylosis cases), 48.6% (18 out of 37 spondylosis cases), 45.5% (30 out of 66 spondylosis cases), 48.0% (24 out of 50 spondylosis cases), 40.0% (18 out of 45 spondylosis cases) and 33.3% (4 out of 12 spondylosis cases). The incidences of bi-segment spondylosis in 4th, 5th, 6th, 7th, 8th and 9th decade were 40.0% (4 out of 10 spondylosis cases), 37.8% (14 out of 37 spondylosis cases), 39.4% (26 out of 66 spondylosis cases), 26.0% (13 out of 50 spondylosis cases), 26.7% (12 out of 45 spondylosis cases) and 50.0% (6 out of 12 spondylosis cases). The incidences of three-segment spondylosis in 4th, 5th, 6th, 7th, 8th and 9th decade were zero, 13.5% (5 out of 37 spondylosis cases), 9.1% (6 out of 66 spondylosis cases), 18.0.% (9 out of 50 spondylosis cases), 26.7% (12 out of 45 spondylosis cases) and 8.3% (1 out of 12 spondylosis cases). The incidences of four-segment spondylosis in 4th, 5th, 6th, 7th, 8th and 9th decade were zero, zero, 4.5% (3 out of 66 spondylosis cases), 8.0% (4 out of 50 spondylosis cases), 4.4% (2 out of 45 spondylosis cases), and 8.3%(1 out of 12 adults). Five-segment spondylosis was found only in two cases; one in

Decade / Number of spondylic segments	Age (decade) 4th 76 pts	5th 107 pts	6th 112 pts	7th 85 pts	8th 64 pts	9th 16 pts	Total
	n: 10 (13.2%)	n: 37 (34.6%)	n: 66 (58.9%)	n: 50 (58.8%)	n: 45 (70.3%)	n: 12 (75.0%)	220 (47.8%)
1 segment	6(60.0%)	18(48.6%)	30(45.5%)	24(48.0%)	18(40.0%)	4(33.3%)	100(45.5%)
2 segments	4(40.0%)	14(37.8%)	26(39.4%)	13(26.0%)	12(26.7%)	6(50.0%)	75(34.1%)
3 segments	none	5(13.5%)	6(9.1%)	9(18.0%)	12(26.7%)	1(8.3%)	33(15.0%)
4 segments	none	none	3(4.5%)	4(8.0%)	2(4.4%)	1(8.3%)	10(4.5%)
5 segments	none	none	1(1.5%)	none	1(2.2%)	none	2(0.9%)
Total 220 patients (pts)	13.2% 10/76 pts	34.6% 37/107 pts	58.9% 66/112 Pts	58.8% 50/85 Pts	70.3% 45/64 Pts	75.0% 12/16 Pts	

Table 2: Age-matched radiographic incidences of cervical spondylosis and numbers of spondylotic segment in each individual among 220 spondylosis patients out of 460 Korean adults.

Patient number with spondylosis and number of spondylotic segment							
	4th	**5th**	**6th**	**7th**	**8th**	**9th**	**Total**
Number of patients	10 (4.6%)	37 (16.9%)	66 (30.3%)	50 (22.9%)	45 (20.6%)	12 (5.5%)	220
Number of Spondylotic segments	14	61	117	93	91	23	399
Severity of disc generation							
±	2(14.3%)	7(11.5%)	5(4.3%)	4(4.3%)	3(3.3%)	3(13.0%)	24(6.0%)
+	6(64.3%)	32(52.5%)	54(46.2%)	50(53.3%)	37(40.7%)	15(65.2%)	198(49.6%)
++	3(21.4%)	21(34.4%)	48(41.0%)	28(30.1%)	36(39.6%)	5(21.7%)	141(35.3%)
+++		1(1.6%)	10(8.5%)	11(11.8%)	14(15.4%)		36(9.0%)
++++					1(1.1%)		1(0.25%)

± : Disc height collapse, less than 20% of normal height
+ : Disc height collapse, between 21~40% of normal height
++ : Disc height collapse, between 41~60% of normal height
+++ : Disc height collapse, between 61~80% of normal height
++++ : Disc height collapse, between 81~100% of normal height

Table 3: The average severity of disc degeneration of the spondylotic segment in each decade from fourth to ninth decade (n : 220 patients with spondylosis).

6th decade patient, and the other one in 8th decade patient at C2-7 segments (Figures 1-7).

In summary, the percentage of the patients with spondylosis increased according to the age increase, but not related with age progression. Thus, the severity is assumed to be related with the initiation and observation times of spondylosis (Table 2 – See bottom column, Table 3 – See +++).

Severity of disc degeneration in each decade (Table 3 and Figures 1-7).

In 10 patients with spondylosis out of 76 fourth decade patients, severity of degeneration ranged from ± to ++ ; 2 segments with ± change, 9 segments with + change, and 3 segments with ++ change.

In 37 patients with spondylosis out of 107 5th decade patients, severity of degeneration ranged from ± to +++ ; ± in 7 segments, + in 33 segments, ++ in 21 segments, and +++ in one segment.

In 66 patients with spondylosis out of 112 sixth decade patients, severity of degeneration ranged from ± ~ +++ ; ± in 5 segments, + in 54 segments, ++ in 48 segments, and +++ in 10 segments.

In 50 patients with spondylosis out of 85 seventh decade patients, severity ranged from ± to +++ ; ± in 4 segments, + in 50 segments, ++ in 28 segments, and +++ in 11 segments.

In 45 patients with spondylosis out of 64 eighth decade patients, severity ranged from ± to ++++ ; ± in 3 segments, + in 37 segments, ++ in 36 patients, +++ in 14 segments, and ++++ in one segment.

In 12 patients with spondylosis out of 16 ninth decade patients, severity ranged from ± to ++ ; ± in 3 segments, + in 15 segments, and ++ in 5 segments.

In summary, the overall severity of disc degeneration was mostly within + to ++ (Table 3).

Incidences of spur, anterior ligament ossicle and OALL

Most of the spur formed at the level between C4-5 and C6-7 with some variance. Anterior ligament ossicles also formed between C3 - T1, and mostly at the C5-7 levels. Ossicle in anterior ligament in the fourth, sixth, seventh, eighth, and ninth decade were found in zero%, 32.4% (12 segments), 36.4% (24 segments), 64.0% (32 segments), 31.1% (14 segemtns), and 25.0% (3 segments), respectively (Table 4). In the patients with ossicle, disc height was well maintained in most cases, but it couldn't be maintained in only a few cases (Figures 8-10).

Among the 460 patients in this study, only six patients had olisthesis (vertebral slip); two C5 antelisthesis (anterior slip), and four retrolisthesis [(posterior slip); (1 at C3, 2 at C4 and 1 at C5)], and ossification of posterior longitudinal ligament (OPLL) in three patients. In a 58 year-old male C_{4-5} monosegment ossification of anterior longitudinal ligament (OALL) was observed (Table 5 and Figure 10G).

Cervical sagittal alignment

Cervical sagittal curve gradually became flattened secondary to the progress of spondylosis in all, but it was not related with age. The loss of cervical lordosis depended on the severity of disc degeneration and the numbers of degenerated disks (Figures 2-12).

	Anterior corporal spurs and anterior ligament ossicle formation											
	4th		5th		6th		7th		8th		9th	
	(n : 10)		(n : 37)		(n : 66)		(n : 50)		(n : 45)		(n : 12)	
segnent	Spurs	Ossicle	Spurs	Ossicle	Spurs	Ossicle	Spurs	Ossicle	Spurs	Ossicle	Spurs	Ossicle
C_{2-3}			1									
C_{3-4}							6					
C_{4-5}			2	2	4	1	15	9	4	3		
C_{5-6}	1		16	7	19	10	18	17	15	6	6	1
C_{6-7}	1		4	3	9	10	7	6	13	5	4	2
C_7-T_1					1	3			5		1	
Total	2 (20.0%)	None	23 (62.2%)	12 (32.4%)	23 (34.8%)	24 (36.4%)	46 (92.0%)	32 (64.0%)	37 (82.2%)	14 (31.1%)	11 (91.7%)	3 (25.0%)

	Posterior corporal spurs (transverse ridge)					
segment	4th	5th	6th	7th	8th	9th
C_{2-3}						
C_{3-4}						
C_{4-5}						
C_{5-6}		1	2	3	1	
C_{6-7}			1	1	2	
C_7-T_1						
Total		1	3	4	3	

In the current study the incidences of spur formation was expressed as single type, though traction, claw and uncinate spurs were independently observed. At each spondylotic segment the incidence of spur pairing (paired and unpaired) was surveyed.

Table 4: Incidence of corporal spur and anterior ligament ossicle formed segment out of spondylotic segments of each decade patients with spondylosis from fourth to ninth decade.

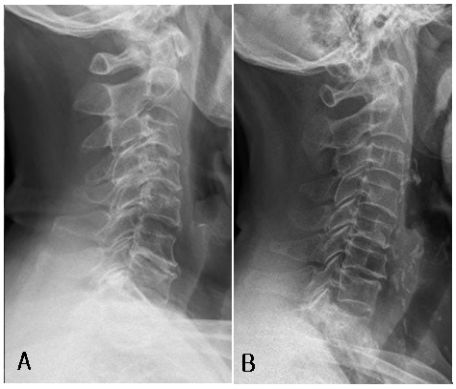

Figure 8: (9th decade). (A): Disc collapse at C_{6-7} with spur and a dotted anterior ligament ossification are seen. (B): Mild disc collapse at C_{5-6} and C_{6-7} with small spur at C_6 inferior corporal edge spur is seen.

Discussion

Cervical spine is composed of 4 identical typical vertebrae with short bifid spinous process (3rd to 6th) and 3 atypical vertebrae (1st, 2nd and 7th). The height of the typical vertebral body is greater posteriorly than anteriorly, and the normal cervical curve is due to disc configuration rather than to the vertebral bodies themselves.

Cervical spondylosis is a manifestation of the aging process which includes both the disc degeneration and diseases of Luschka's and facet joints, and is relatively common. It is known that 50% of the population experience once degenerative arthritis in their life time. Again the degenerative arthritis is found in 97% of the population over age of 60 years. Among them the condition becomes symptomatic in 50% of the men and 25% of the women [1-10,11,16-22].

Whether spondylitis should be called "degenerative change" or "age change" may appear simply a matter of semantics, but the development of osteophytes can be viewed as a reactive and adaptive change that seeks to compensate for biomechanical aberrations.

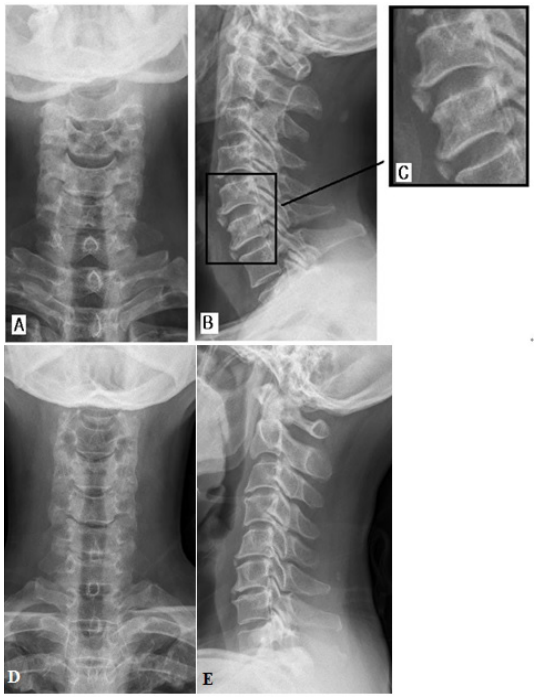

Figure 9: Cervical radiographs (A,B,C) of a 51 year-old man show the ossified anterior anulus and longitudinal ligament of C_{5-6} and C_{6-7}, but disc spaces are well preserved. He complained mild neck pain with intact neurology.
The cervical radiograms of a 50 year-old lady shows the multi-level spondylosis and poterior corporal edge spurs at C_{5-6} and C_{6-7} with some disk collapse in spite of the associated anterior ligament ossicle at C_{5-6} (D,E)

The cardinal feature of spondylosis are said to be the development of osteophytes along the junction of vertebral bodies and their intervertebral discs [5,6].

Degenerative change can start even in the third decade of life, but

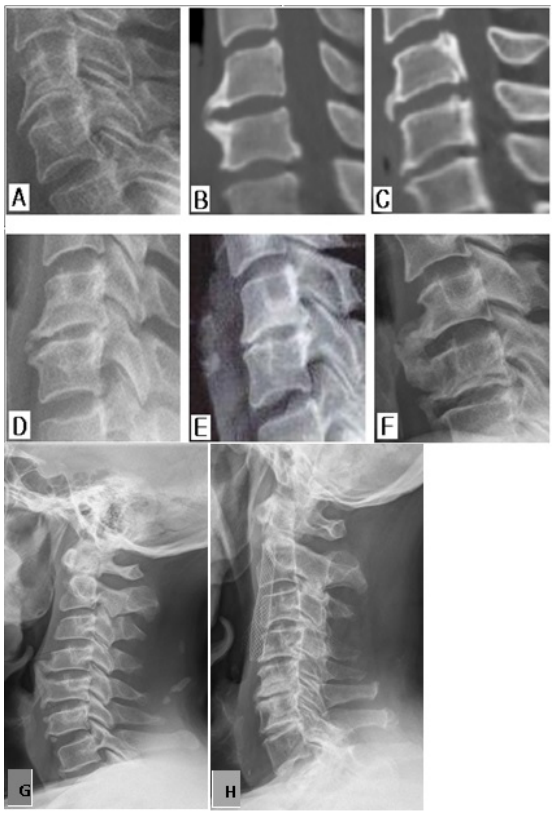

Figure 10: Various types of spondylophytes
A : C_5 inferior overhanging sharp corporal lip (uncinate) spur with mild disc height collapse
B : A paired C_5 inferior and C_6 upper anterior claw spurs without disc height collapse (CT)
C : A large unpaired C_5 anterior inferior claw spur and a paired C_6 inferior and C_7 upper marginal claw spurs
D : A paired anterior and posterior corporal osteophytes with one-half disc height collapse
E : A small unpaired C_5 inferior spur and relatively large posterior paired claw spurs with one-quarter disc height collapse, discogenic osteosclerosis of C_5 inferior end-plate.
F : An example of giant anterior ossicle connected with paired claw spur at C_{5-6} and paired anterior spurs at C_{6-7} in a 59 year-old man
G : Sagittal radiogram in a 58 year-old male shows well preserved C_{4-5} disc space with a monosegment free "plate-form ossification of anterior longitudinal ligament", presumably the variant uncinate ossification of anterior longitudinal ligament (OALL), pushing the formed C_4 and C_5 anterior inferior claw spurs up- and downwardly, and also shows the paired anterior spurs in C_{6-7} and C_7-T_1, segments. All disc spaces are well preserved.
H : Cervical radiograms of a 82 year-old man show two level spondylosis C_{4-5} and C_{5-6} with rather flattened sagittal curve C_{1-6}, and also show anterior and posterior spurs at C_{4-5} and C_{5-6}, and discogenic subchondral osteosclerosis of caudal half of C_5 and upper part of C_6.

Olisthesis \ Age	Decades						Total
	4th (n: 76)	5th (n: 107)	6th (n: 112)	7th (n: 85)	8th (n: 64)	9th (n: 16)	
Ante-listhesis (n: 2)			C_5: 1			C_5: 1	2
Retro-listhesis (n: 4)		C_4: 1 C_5: 1	C_4: 1		C_3: 1		4
OPLL (n: 3)		1	2				3
OALL (n: 1)			1				1

Table 5: Age-related radiographic incidence of olisthesis, OPLL and OALL in 220 patients with degenerative discs out of 460 patients.

Figure 11: A. Cervical radiogram of a 47 year-old male show C_4 antelisthesis with angular kyphotic deformity at C_{4-5} disc level and slightly narrowed disc space of C_{4-5} and C_{5-6}.
B. Simple radiograms of a 77 year-old lady show sagittally straight neck and narrowed C_{3-4} disc and C_3 retrolisthesis.

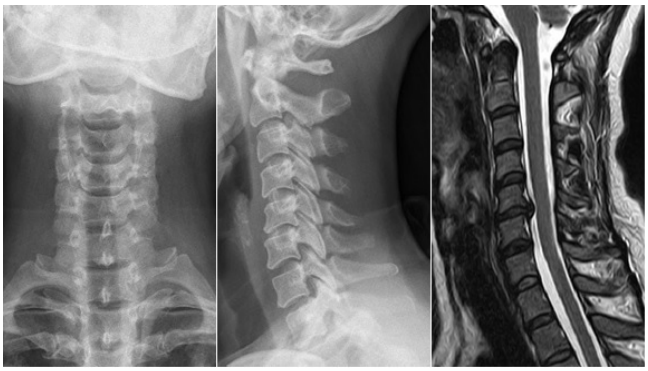

Figure 12: A 41 year-old lady complained neck pain and tingling sensation in the left arm. Cervical radiograms show slightly narrowed C_{5-6} disc space with flattered sagittal curve. No spur or ossicles are seen. MRI shows the centrally herniated disc.

is not found in the third decade patients in the current series. The degenerative changes initiate first at the intervertebral disc, Luschka's and facet joints in order [4,13-15]. When the spur was found in the evolutional process of degeneration, it was named spondylosis by Epstein, marginal spondylosis by Borak, and osteophytosis by Collins [3,20].

The main cause of disc space narrowing is known to be the degenerative changes of the Luschka's joints, while degenerative changes of the facet joints rarely caused the disc space narrowing and foraminal stenosis.

Payne and Spillane reported that cervical spine had smaller foramen which formed the inner wall of the neural foramen and closely contacted with the nerve roots. Thus, the spurs of the Luschka's joint is

the main source causing the radicular symptoms through the sensory branch [8].

De Palma and Rothman in 1970 reported their study results of 70 autopsied cervical spines, aged from 38 to 95 years, and noted that degeneration affected the entire cervical spine and was generally age-related [6]. 72% of individuals of specimen over 70 years had several abnormalities and the C5-6 level was the most frequently involved, followed by C6-7, with the C2-3 level least involved. The marked narrowing of the disc was associated with fissures, extending into and becoming continuous with fissures and Luschka's joints. Nuclear material extended under the longitudinal ligament into the Luschka's joints and even into the adjacent vertebral bodies. The Luschka's joints were markedly altered in the lower three levels, most frequently at the C5-6 region. This observation was also been made by Robinson and Smith following anterior cervical interbody fusion [9].

Up to now none studied previously the severity of the degenerative disks, spur and ossicle formation of the anterior ligament and their relationships. In the current authors' studies, severity of the degenerative disks ranged widely, but mostly were within the +~++. Also the degenerated segments were mostly localized to C4-7 levels (Tables 3 and 4).

It was assumed that anterior ligament ossicle and OALL contributed to the stability of the degenerated disc segment, and consequently maintained the normal disk height from collapse (Figures 8, 9 and 10G). There was no necessity of statistical assessment to prove it. Thus, it is thought that ossicle and OALL in anterior ligament are the good omen indicating the supporting role for the segment.

However, simple radiograms were found to be low diagnostic accuracy in detecting the posterior corporal spur and Luschka's joint arthropathy. Also it was an interesting finding that anterior corporal edge spurs accompanied the posterior spurs in very low rates.

Up to now none studied the age-matched incidences of spondylosis, the numbers of spondylotic segments, severity of degenerative disks, and cervical curve changes. Also there is no study yet on the relationship between the degenerative discs, the spurs, anterior ligament ossicle and OALL and segmental stability. Only in a few segments with anterior ligament ossicle disc space became slightly narrowed, while most of the segments with uncinate spur (anterior inferior edge spur) became narrowed. It is thought that spur does two roles ; ① Beneficial stabilizing and disc collapse prevention role for the same segment, and ② as harmful role pain-provocation and surrounding tissue compression. Anterior corporal marginal claw and traction spur can displace and compress the anterior organs such as esophagus and trachea when its size is excessively large, while the posterior ridge spur precipitates clinical symptoms and signs more frequently than the anterior spur in spite of its low incidences and its smaller size. It was thought that ossicle in anterior ligament including OALL does beneficial role, but not necessarily in all.

Retrolisthesis developed in 4 cases in different level in the current series; one at C3, two at C4 and one at C5. Thus, this fact contradicted Hayashi et al's report. OPLL seemed not related with the degenerative disks.

The current authors could not find out the age-specific characteristic radiographic images of cervical spondylosis except the increased severity and increased incidences of degenerate disks and segments according to age increase. The loss of cervical lordosis depended on the severity of disc degeneration, and the numbers of the degenerated disks, and thus there were no age-matched differences in cervical lordosis.

The incidences of cervical spondylosis in the Jeju islanders were similar to the mainlanders [10], though their living habits were somewhat different in the females.

The following items can be listed as limitations of the current study. Most important limitation of this study is the lack of longitudinal study for each individual, and of the gene morphophisms for spurs [23]. Credibility of assessment, accuracy, feasibility in applying the radiographic findings to management, and lack of routine CT, MRI, and repeated MRI study with certain intervals can be listed as secondary limitations. The lack of information related with age-matched signal changes on MRI that occur within disk over time can be listed as another important limitation. But inter- and intra-observer disagreement and difficulty of disc height measurement in MR grading classification system can be listed as limitation, though Pfirrmann et al. reported that MR grading provided the reliable assessment of MRI disc morphology [24,25]. Thus, the current authors view is that MR classification system of disc degeneration is not superior to the simple radiographic assessment in the clinical practice.

Cevical spondylosis in the elderly is the age-related inevitable progressive degenerative changes which deteriorate the individual's physical function including independence, and progresses further and more symptomatic if not properly cared.

Fortunately in spite of the higher incidences of spondylosis, it was clearly known that even symptomatic spondylotic patients complaining shoulder-neck-brachial pain were well controlled by conservative means, and only a few were subjected to surgery [13-15]. However, the high incidences of spondylosis in Jeju islanders suggest us that functional health maintenance and protection of the musculoskeletal system of the islanders will be a clinical issue in deterring the progressive decline of physical function and loss of independence. Thus, understanding the age-related changes in the musculoskeletal function and being able to differentiate those from the other ailment are essential to maintain the function of the spinal column.

In the current study the authors did not deal with the management. However, it is our views that surgical management such as decompression and/or fusion surgery must be the last resort when all the conservative management fail. Because the surgery-related systemic and local complications are reported rather high in the elderly population [15].

In the conservative management of the symptomatic spondylosis pain-relief must be the first step and secondly the maintenance of physical independence. Then a specific physical exercise programs on the elderly individual should be tailored to the specific needs of the patients and should be designed to offset age- and inactivity-related musculoskeletal change which minimizes the risk of conservative physical therapy.

Thus, this study is a timely one which provides the new information's in caring the aged individuals with cervical spondylosis.

Present study discussed the different types of osteophytes, not based on the hitherto proposed theory that osteophyte development follows disc height reduction.

In conclusion, conventional simple cervical radiograms in 4 projections remain cost-effective basic imaging study to detect early disc degeneration, and to be very reliable diagnostic tool in assessing the degenerative processes of cervical spine, and provide the managing direction of the cervical spine disorders.

Conflict of Interest

No benefit in any form has been received by the authors from a commercial party related with directly or indirectly to the subject of this manuscript. This study was approved by the participating institutional review board. Informed consent was obtained from the patients.

No potential conflict of interest relevant to this article.

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