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THORACIC POSTERIOR LONGITUDINAL LIGAMENT OSSIFICATION IN A FIXED POPULATION: ITS RADIOLOGICAL AND NEUROLOGICAL MANIFESTATIONS

固定集団における胸椎後縦靱帯骨化症:
レントゲン学的及び神経学的所見

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SUMMARY

Posterior longitudinal ligament ossification (PLLO) reportedly usually involves the cervical spine, and often accompanies other ligamentous ossification, such as diffuse idiopathic skeletal hyperostosis. PLLO is considered a serious disease, because it sometimes causes severe radiculomyelopathy. However, the present study, whose focus was a fixed population sample, revealed that PLLO of the thoracic spine is nearly always asymptomatic.

The prevalence of thoracic PLLO was 0.6%, with a predominance among females by a factor of three, contrary to cervical PLLO which was predominantly among males. No marked radiculomyelopathy was observed in subjects of the present investigation, and there was no definite evidence of neurological involvement due to thoracic PLLO. Ankylosing spinal hyperostosis was rare among our PLLO subjects, especially among the females. PLLO in the thoracic region cannot be regarded as a part of ankylosing spinal hyperostosis or diffuse idiopathic skeletal hyperostosis.

要 約

後縦靭帯骨化症は通常頚椎に起こり，特発性全身性過骨症のような他の靭帯骨化症を伴うことが多いと報告されている．後縦靭帯骨化症は重篤な疾患とされており，重篤な神経根脊髄症を引き起こすこともある．しかし，固定集団を対象として行った本調査では，胸椎後縦靭帯骨化症は無症候性であることが多いということが明らかになった．

胸椎後縦靭帯骨化症の有病率は0.6%であり，女性の有病率は男性の3倍であった．これは，頚椎後縦靭帯骨化症が主として男性に見られたこととは逆の所見であった．本調査対象者には顕著な神経根脊髄症は認められなかった．また，胸椎後縦靭帯骨化症による神経学的障害の明確な兆候はなかった．本調査における胸椎後縦靭帯骨化症例では，強直性脊椎過骨症は特に女性においてまれであった．胸椎における後縦靭帯骨化症は，強直性脊椎過骨症や特発性全身性過骨症の一部であるとみなすことはできない．

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INTRODUCTION

In 1960, Tsukimoto[1] reported the first autopsied case of myelopathy due to cervical posterior longitudinal ligament ossification (PLLO). In Japan this entity has since received much attention because of the myeloradiculopathy and paraplegia it frequently causes. In 1975 the Japanese Ministry of Health and Welfare categorized it as a special "incurable" disease. It is being intensively investigated, mainly by orthopedic surgeons and neurologists. Since the symptoms PLLO causes are sometimes confused with those of spinal cord tumors, myelitis, cervical spondylosis, and herniated disks, it must be considered along with these diseases in a differential diagnosis.

As a result of the numerous reports of cervical PLLO among the Japanese and relatively few cases among Caucasians,[2-5] it has been regarded as a disease occurring predominantly in Japanese. In 1976 Yamauchi et al[6] reviewed the lateral radiographs of the cervical spines of 854 Caucasian Mayo Clinic patients and found only two cases of cervical PLLO - a frequency much lower than among Japanese. The reported prevalence of cervical PLLO among Japanese with cervical symptoms ranges from 1%-3%,[7-11] with a predominance among males by a factor of two.[12]

PLLO in the thoracic and lumbar regions reportedly causes severe myelopathy.[13-20] According to the Japanese Ministry of Health and Welfare,[13] 292 (10%) of 2,808 Japanese with cervical PLLO also had thoracic and lumbar involvement. However, thoracic PLLO was not fully investigated because its study began with cervical PLLO.

This report of thoracic PLLO includes 1) estimates of its prevalence among Adult Health Study (AHS)[21] participants based on lateral chest radiography, 2) its radiological and neurological manifestations, 3) comparisons of the radiographic findings of asymptomatic with symptomatic cases reported by other investigators, and 4) a discussion of factors thought to cause thoracic PLLO.

MATERIALS AND METHODS

Subjects of the present investigation are members of the fixed population, participants in the AHS, a long-term follow-up program of biennial clinical examinations of atomic bomb survivors and comparison subjects, originally numbering

緒　言

1960年に月本[1]は，頚椎後縦靭帯骨化症による脊髄症の最初の剖検例を報告した．この疾患は脊髄神経根症及び対麻痺をもたらすことが多いので，日本ではそれ以来，注目を集めている．1975年，厚生省はこれを"特定疾患"と指定した．現在，整形外科医及び神経科専門医を中心に強力な調査が行われている．後縦靭帯骨化症の症状から，時に脊髄腫瘍，脊髄炎，頚椎脊椎症及び椎間板ヘルニアと混同されることがあるので，鑑別診断ではこれらの疾患の可能性についても考慮する必要がある．

本症が日本人に多く，欧米人に比較的少ない[2-5]ところから，日本人に多く発生する疾患として考えられている．1976年，山内ら[6]は，米国 Mayo Clinic の白人患者854例の頚椎側方向X線写真について検討を行い，わずか2例の後縦靭帯骨化症を認めたにすぎない．この頻度は日本人におけるよりもはるかに少ないものであった．日本人における頚椎後縦靭帯骨化症の有病率は1％～3％で，[7-11] 男性の有病率は女性の2倍であると報告されている．[12]

胸椎及び腰椎の後縦靭帯骨化症は重度の脊髄症の因となると報告されている．[13-20] 厚生省[13]によれば，頚椎後縦靭帯骨化症を有する日本人2,808人中292人（10％）に胸椎及び腰椎にも骨化症があった．しかし，厚生省の調査では，胸椎後縦靭帯骨化症は頚椎後縦靭帯骨化症を出発点としたため，十分研究されていない．

胸椎後縦靭帯骨化症に関する本報では，次の各項を含む．すなわち，1) 成人健康調査集団[21]におけるその有病率を側方向胸部X線像に基づいて推定，2) その放射線学的及び神経学的所見，3) 他の研究者が報告した有症候例と無症候例の放射線学的所見との比較，及び 4) 胸椎後縦靭帯骨化症の原因と考えられる要因についての検討．

材料及び方法

本調査は，原爆の後発性放射線影響を調べるために当初20,000人で構成された原爆被爆者及びその対照者を対象に，2年ごとに検診を行う長期的な追跡調査である成人健康調査の固定集団を対象にした．

20,000, to detect late radiation effects of the A-bombs. All AHS subjects undergo complete physical examinations and laboratory studies, including posteroanterior stereoscopic and lateral chest radiography. Other examinations, including radiography and fluoroscopy of other body sites, are performed when clinically indicated. All serial radiographs obtained during these examinations are permanently retained and available for comparison during longitudinal investigations.

この調査集団は全員胸部の背腹方向立体X線撮影，及び側方向胸部X線撮影を含む完全な診察及び臨床検査を受ける．そのほか臨床的に必要とされる場合は，その他の部位の直接撮影及び透視検査なども行う．これらの検診で撮影された一連のX線写真はすべて永久保存とされ，縦断的調査中いつでも比較のため利用できる．

Ossification of the posterior longitudinal ligament was observed from the intervertebral spaces of T2-3 to T12-L1 and it was relatively easily detected by lateral chest radiography providing the spine was well visualized and scrutinized. To estimate the prevalence of thoracic PLLO, the lateral chest radiographs of 6,037 Hiroshima and 2,573 Nagasaki AHS subjects were reviewed. These subjects were examined from 7 November 1977 to 6 November 1979, and from 4 January 1977 to 28 December 1978, respectively. During these examinations 35 Hiroshima and 13 Nagasaki thoracic PLLO cases were detected. Seven additional AHS cases of thoracic PLLO detected outside these periods were added, bringing the total available for study to 55.

後縦靭帯骨化症は，第2－3胸椎から第12胸椎－第1腰椎までの椎間腔で観察され，脊柱が十分描出された場合は，側方向胸部X線写真によって比較的容易に探知された．胸椎後縦靭帯骨化症の有病率を推定するため，成人健康調査の対象者広島6,037例，長崎2,573例の側方向胸部X線写真を検討した．これらの対象者は，それぞれ1977年11月7日～1979年11月6日及び1977年1月4日～1978年12月28日の間に検査を受けていた．この間に広島で35人長崎で13人の胸椎後縦靭帯骨化症の症例が認められた．成人健康調査の対象者でこの期間外に探知された胸椎後縦靭帯骨化症7例も加えた．したがって，調査のために入手された症例は合計55例となった．

Nearly all thoracic PLLO patients cooperating in this study received lateral radiography of the entire spine, oblique radiography of the cervical spine, and lateral tomography of the PLLO-involved sites. The relationships between PLLO in the thoracic, cervical, and lumbar regions, and those with ligamenta flava ossification, ankylosing spinal hyperostosis, ligamentum nuchae ossification, and cervical spondylosis were investigated. Forty-one of the 55 subjects in this study received complete neurological examinations.

本調査に協力した大部分の胸椎後縦靭帯骨化症例に対して，全脊柱の側方向撮影，頸椎の斜方向撮影及び後縦靭帯骨化のある部位の側方向断層撮影を行った．胸椎，頸椎及び腰椎における後縦靭帯骨化症相互間の関係，並びにそれらと黄色靭帯骨化症，強直性脊椎過骨症，項靭帯骨化症及び頸椎症との関係を調べた．55例中41例は完全な神経学的診察を受けた．

RESULTS

Prevalence by Sex and Age

Thoracic PLLO was detected in 30 females and 5 males in Hiroshima, and in 10 females and 3 males in Nagasaki. The results by age and sex for both cities are shown in Table 1. Following χ^2 analysis, there was no statistically significant difference ($P<.05$) between the rates for females in the two cities. Thoracic PLLO was detected in persons 40 years of age and over, with a predominance among females by a factor of three. In females, 40 years of age and older, the rate did not correlate statistically with age.

結　果

性及び年齢別有病率

胸椎後縦靭帯骨化症は，広島では女性30例，男性5例に，また長崎では女性10例男性3例に認められた．両市における年齢及び性別の結果は表1に示した．χ^2 解析では，両市の女性の有病率には統計学的に有意な差（$P<.05$）はみられなかった．胸椎後縦靭帯骨化症は40歳以上の人に認められ，女性において男性より3倍多い．40歳以上の女性では，その率と年齢との間に統計学的相関はなかった．

TABLE 1 PREVALENCE OF THORACIC PLLO BY AGE AT EXAMINATION AND SEX
表1 胸椎後縦靭帯骨化症の有病率；診察時年齢及び性別

Age	Male			Female		
	Thoracic PLLO	AHS	Rate (%)	Thoracic PLLO	AHS	Rate (%)
			Hiroshima			
30-39		267			206	
40-49		458		5	733	0.68
50-59	3	495	0.61	9	1264	0.71
60-69	1	425	0.35	8	856	0.93
70-79	1	383	0.26	7	622	1.1
80-89		116		1	106	0.94
90-99		4			2	
Total	5	2148	0.23	30	3889	0.77
			Nagasaki			
30-39		120			149	
40-49		306		4	520	0.77
50-59	2	223	0.90	4	506	0.79
60-69		216		1	238	0.42
70-79	1	134	0.75	1	117	0.85
80-89		25			19	
Total	3	1024	0.29	10	1549	0.65
			Total			
30-39		387			455	
40-49		764		9	1253	0.72
50-59	5	718	0.73	13	1770	0.73
60-69	1	641	0.16	9	1094	0.82
70-79	2	517	0.39	8	739	1.0
80-89		141		1	125	0.80
90-99		4			2	
Total	8	3172	0.25	40	5438	0.74

The prevalence of thoracic PLLO was 0.56.
胸椎後縦靭帯骨化症の有病率は0.56.
Hiroshima subjects examined from 7 November 1977 to 6 November 1979.
広島の対象者は1977年11月7日から1979年11月6日までの間に受診したもの.
Nagasaki subjects examined from 4 January 1977 to 28 December 1978.
長崎の対象者は1977年1月4日から1978年12月28日までの間に受診したもの.

Radiological Manifestations

Sites of Thoracic PLLO. The sites involved by PLLO are shown in Figure 1. The maximum extent (percent) of occlusion of the spinal canals by PLLO are indicated and are based on the thicknesses of ossification as assessed by lateral tomography. Thoracic PLLO was classified according to the involved sites as: 1) upper mid-thoracic, mainly about the region of T6; 2) both upper mid-thoracic and lower thoracic; and 3) lower thoracic, mainly to the T12-L1 region. There were 38, 9, and 8 of these cases, respectively.

Types of Thoracic PLLO. Thoracic PLLO was categorized by its radiological appearance as:

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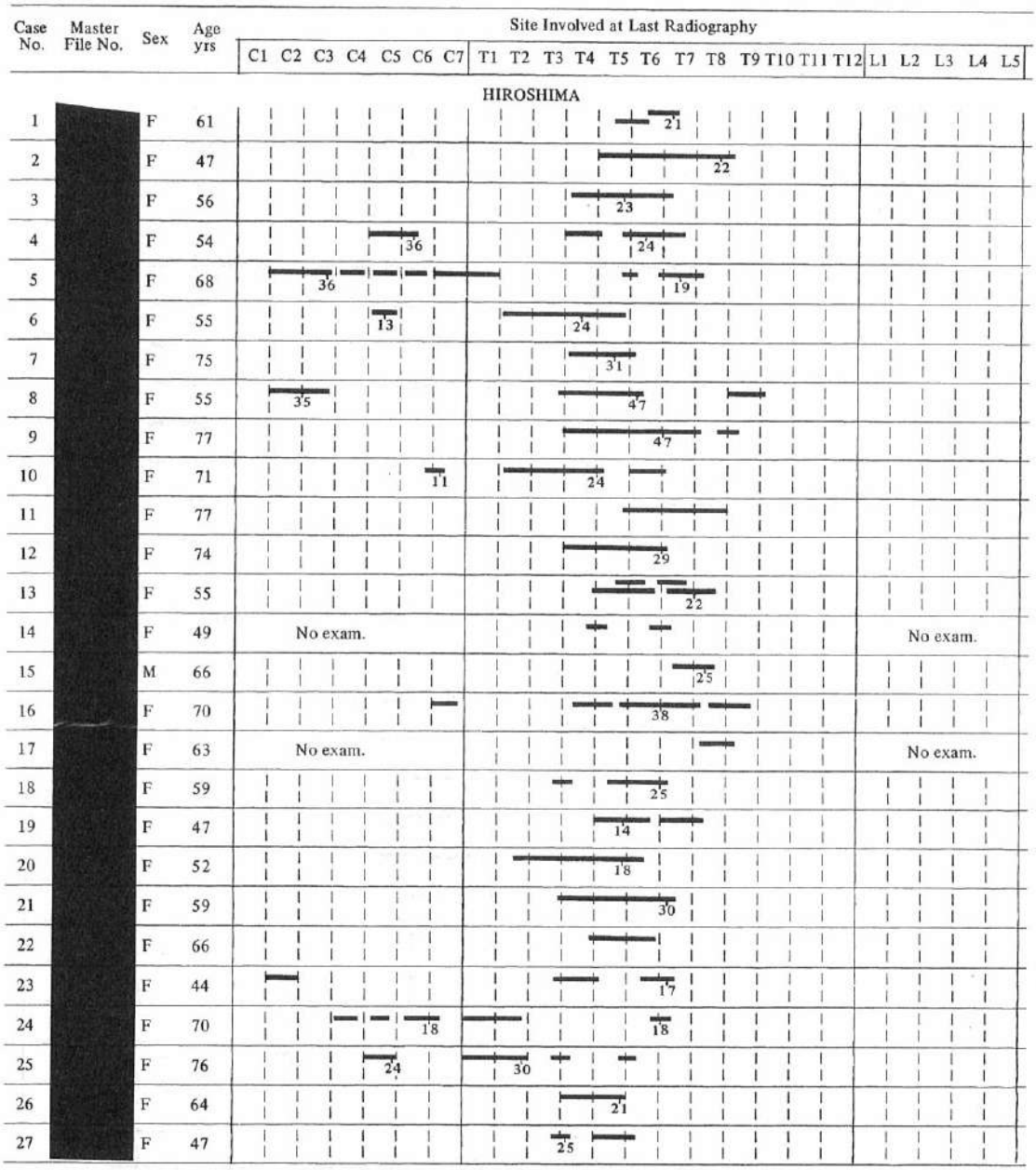
胸椎後縦靭帯骨化症の部位. 図1は後縦靭帯骨化症の部位を示したものである. 後縦靭帯骨化症による脊柱管の最大狭窄率(%)を示したが, これは側方向断層撮影で評価された骨化の厚さに基づいたものである. 胸椎後縦靭帯骨化症を次の骨化部位に分類した. 1) 胸椎上中部, 主として第6胸椎周辺; 2) 胸椎上中部及び下部の混在; 3) 胸椎下部, 主として第12胸椎と第1腰椎周辺. これらの例は, それぞれ38例, 9例, 及び8例あった.

胸椎後縦靭帯骨化症の種類. 胸椎後縦靭帯骨化症

FIGURE 1 RADIOLOGICAL MANIFESTATIONS OF THORACIC PLLO, HIROSHIMA AND NAGASAKI
図 1　胸椎後縦靭帯骨化症の放射線学的所見；広島及び長崎



Numbers indicate the maximum percent occlusion of the spinal canal due to PLLO by site in all cases for whom tomography was performed.
数字は，後縦靭帯骨化症による脊柱管狭窄の最大百分率を，断層撮影を行った全例について部位別に示したものである．

Case No.	Master File No.	Sex	Age yrs	Site Involved at Last Radiography: C1 C2 C3 C4 C5 C6 C7 T1 T2 T3 T4 T5 T6 T7 T8 T9 T10 T11 T12 L1 L2 L3 L4 L5
				HIROSHIMA
28		F	69	17
29		F	52	26 15
30		F	63	29 13
31		F	85	16 38
32		M	58	31 40 44 40
33		F	66	No exam.
34		F	76	No exam.
35		M	52	35 28 20
36		F	54	24 25
37		F	63	20
38		M	58	21 50
39		F	72	29
40		M	79	27
41		M	52	12
				NAGASAKI
42		F	69	21
43		F	74	22
44		F	50	17
45		F	53	22
46		F	49	29
47		F	58	16
48		F	48	26
49		F	47	25
50		F	49	No exam. No exam.
51		M	52	22
52		M	51	No exam.
53		M	73	No exam.
54		F	58	39 44
55		F	41	

1) bridge, 2) linear, and 3) combined bridge and linear. In the upper mid-thoracic PLLO, the combined bridge and linear type was frequently noted. Except for three cases (Cases 32, 53, and 54), all lower thoracic PLLO was of the segmented bridge type. In the linear type, the vertebral body itself appeared unaltered (Figure 2). In 15 cases, lateral tomography demonstrated linear radiolucencies between the posterior aspects of the vertebral bodies and the ossifications (Figure 3). The bridge-type ossification near the intervertebral spaces appeared to be continuous with the vertebral bodies (Figures 4 and 5). The vertebral bodies with bridge-type involvement apparently had been altered. In two cases (Cases 1 and 13), the ossification was laminated (Figure 6). The number of cases by site of ossification and type were as follows:

はその放射線学的様相から1)橋状，2)線形及び3)橋状・線形混合型，に分類された．胸椎上中部骨化例では，橋状・線形混合型が多く認められた．3例(症例32，53，54)を除き，胸椎下部骨化例では，すべて分節橋状型であった．線形型では，椎体自体には変形は認められなかった(図2)．15例には，側方向断層撮影で骨化部位と椎体後部との間に線形の放射線透過部を認めた(図3)．椎体間腔付近の橋状骨化は，椎体と連続しているように見受けられた(図4，5)．橋状骨化の見られた椎体には変形があるように思われた．2例(症例1と13)における骨化は層状であった(図6)．骨化部位及び種類別症例数は次のとおりである．

Thoracic Site 胸椎部位		Type 種　類	
Upper mid 上中部	38 cases 例	Bridge 橋状	16 cases 例
		Linear (about T6) 線形(第6胸椎周辺)	9 cases 例
		Combined 混合	22 cases 例
Both upper mid 上中部 / lower 下部混在	9 cases 例		
Lower 下部	8 cases 例	Segmental bridge 分節橋状	14 cases 例
		Extensive linear 広範線形	3 cases 例

Associated Radiological Manifestations

Radiologically associated with thoracic PLLO were cervical and lumbar PLLO, ankylosing spinal hyperostosis, degenerative abnormalities of the thoracic spine, ligamenta flava ossification, ligamentum nuchae ossification, and cervical spondylosis (Table 2). The degenerative abnormalities included disc disease and so-called spondylosis deformans. Each of these was categorized as minimal, moderate, or marked. Table 3 summarizes the results. Lumbar and cervical PLLO each occurred with thoracic PLLO in 29% and 25% of the cases, respectively. There was no correlation between the presense or degree of cervical and lumbar PLLO, and the degree of thoracic PLLO. Cervical and lumbar PLLO were more frequently detected in male than female subjects with thoracic PLLO.

Thoracic PLLO occurred with ankylosing spinal hyperostosis in 11/46 cases (24%) with cervical involvement; 15/55 cases (27%) with thoracic

関連ある放射線学的所見

胸椎後縦靭帯骨化症と関連のある放射線学的所見としては，頚椎及び腰椎の後縦靭帯骨化症，強直性脊椎過骨症，胸椎退行性変化，黄色靭帯骨化症，項靭帯骨化症，及び頚椎症であった(表2)．退行性異常には，椎間板疾患及びいわゆる変形性脊椎症が含まれている．これらはそれぞれ，微少，中等度又は著明と分類された．表3ではその結果を要約して示した．胸椎後縦靭帯骨化症の29%と25%に腰椎及び頚椎の後縦靭帯骨化症を伴っていた．頚椎及び腰椎の後縦靭帯骨化症と胸椎後縦靭帯骨化症の有無及び程度との間には相関はなかった．胸椎後縦靭帯骨化症例において，頚椎及び腰椎後縦靭帯骨化の併発は女性よりも男性に多く認められた．

強直性脊椎過骨症と胸椎後縦靭帯骨化症との併発は，頚椎では11／46例(24%)，胸椎では15／55例

TABLE 2 ASSOCIATED RADIOLOGICAL MANIFESTATIONS IN THORACIC PLLO–HIROSHIMA AND NAGASAKI
表 2　胸椎後縦靭帯骨化症と関連のある放射線学的所見；広島及び長崎

Case No.	Master File No.	Sex	Age yrs	ASH C-spine	ASH T-spine	ASH L-spine	CS	DA in T-spine	LNO	LFO	Other
						HIROSHIMA					
1		F	61	–	–	–	+	–	–	–	
2		F	47	–	–	–	–	–	–	–	
3		F	56	–	–	–	++	+	–	–	
4		F	54	+	–	–	–	+	–	–	
5		F	68	–	–	–	–	+	–	T6-7, T7-8, T8-9	
6		F	55	–	–	–	–	–	+	–	
7		F	75	–	–	–	++	+	–	–	Compression fracture (T12)
8		F	55	–	+	–	+	–	+	T10-11, T11-12, L1-2, L2-3	
9		F	77	–	–	–	+++	++	–	T7-8, T8-9, T10-11	
10		F	71	–	–	–	++	+	–	–	
11		F	77	–	–	–	–	+	–	–	
12		F	74	–	–	–	+	+++	–	–	Compression fractures (T6, T7, T8)
13		F	55	–	–	–	–	+	–	T9-10	
14		F	49	.	–	.	.	–	.	.	
15		M	66	++	++	+	++	+	–	T10-11	
16		F	70	+	–	+	+++	++	–	–	
17		F	63	.	–	.	.	+	.	.	
18		F	59	–	–	–	–	–	–	T5-6, T6-7, T8-9, T9-10	
19		F	47	–	–	–	–	+	–	–	
20		F	52	–	–	–	–	–	–	–	
21		F	59	–	–	+	–	–	–	–	
22		F	66	.	–	.	.	+	–	.	
23		F	44	–	–	–	–	+	–	T9-10, T10-11	
24		F	70	+	+	–	–	+	–	–	Kyphosis
25		F	76	++	+++	++	++	+++	–	–	Kyphosis
26		F	64	–	–	–	–	+	+	–	
27		F	47	–	–	–	++	–	+	–	
28		F	69	–	+	+	+	+	+	T8-9	
29		F	52	–	–	–	+	–	–	T4-5, T7-8, T8-9, T10-11	
30		F	63	–	–	–	–	+	–	T5-6, T6-7, T7-8, T10-11, T11-12	
31		F	85	–	++	–	+	++	–	–	Kyphosis, compression fractures (T12, L1)
32		M	58	+++	+	++	–	–	–	T10-11, T11-12	Ossified supraspinous ligament
33		F	66	.	–	++	.	+	.	.	Kyphosis Compression fracture (T11)
34		F	76	.	++	+	.	++	.	.	Kyphosis
35		M	52	+++	+++	++	–	–	+	L1-2	
36		F	54	–	–	–	++	+	–	T10-11, T11-12	
37		F	63	–	–	–	++	++	+	–	
38		M	58	+	++	++	–	+	–	–	Compression fracture (T12)
39		F	72	–	–	–	++	+	–	–	
40		M	79	+	++	++	+	–	–	–	
41		M	52	+++	+	+	–	++	+	–	Ossified supraspinous ligament
						NAGASAKI					
42		F	69	–	–	–	–	–	–	–	
43		F	74	–	–	–	–	+	–	–	Kyphosis Compression fractures (L1, L3)
44		F	50	–	–	–	–	+	–	–	
45		F	53	–	–	–	–	–	–	T7-8	Schmorl's nodes (T9, T10)
46		F	49	–	–	–	–	+	–	T7-8, T8-9, T10-11, T11-12, T12-L1	
47		F	58	–	+	–	–	–	–	T11-12	
48		F	48	–	–	–	–	+	+	T6-7, T7-8	
49		F	47	.	–	–	.	–	.	.	
50		F	49	.	–	.	.	–	.	.	
51		M	52	+	+++	+++	–	+	+	T11-12	
52		M	51	.	–	–	.	–	.	.	
53		M	72	.	+++	+++	.	+	.	.	
54		F	58	–	–	++	++	+++	–	–	
55		F	41	–	–	–	.	–	–	–	

ASH - Ankylosing spinal hyperostosis 強直性脊椎過骨症
CS - Cervical spondylosis 頚椎脊椎症
DA - Degenerative abnormalities 退行性変化
LNO - Ligamentum nuchae ossification 項靭帯骨化症
LFO - Ligamenta flava ossification 黄色靭帯骨化症
. No examination 検査を受けなかった者
– Negative 陰性
\+ Minimal 微少
++ Moderate 中等度
+++ Marked 著明

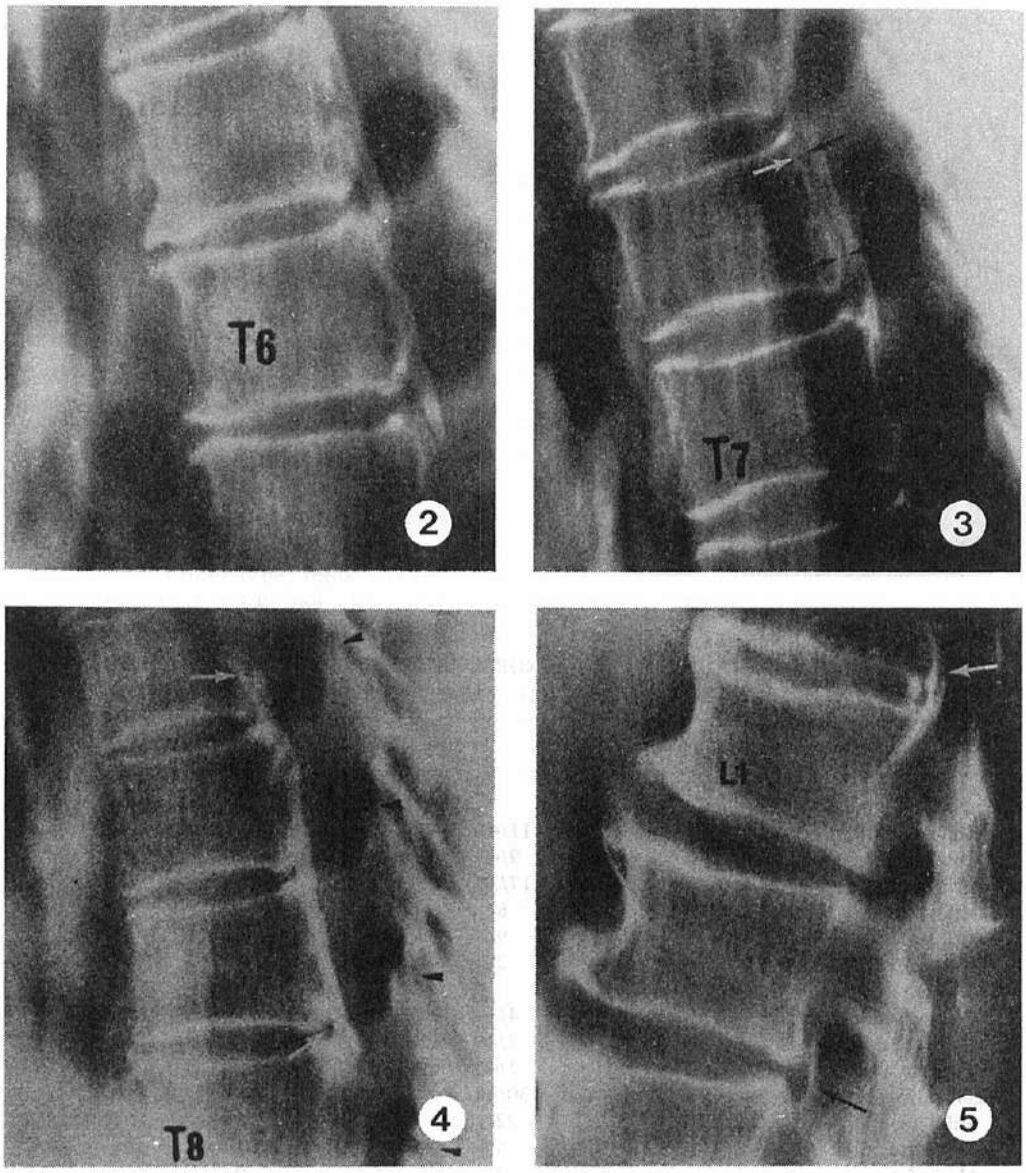


Figure 2. Case 3-Lateral tomogram of thoracic spine shows linear PLLO in the upper mid-thoracic region. Figure 3. Case 43-Lateral thoracic spine tomogram shows a linear radiolucency (arrows) between the posterior aspects of the vertebral bodies and the upper mid-thoracic PLLO. Figure 4. Case 29-Lateral tomogram of thoracic spine shows combined-type PLLO (arrows) with ligamenta flava ossification (arrowheads). Figure 5. Case 38-Lateral thoracolumbar tomogram shows segmental bridge-type PLLO (arrows) posterior to the intervertebral spaces at T12-L1 and L2-3. Moderate ossification anterior to the vertebrae (ankylosing spinal hyperostosis) is also seen.

図2．症例3：胸椎の側方向断層撮影像では，胸椎上中部の線形後縦靭帯骨化症を示す．　図3．症例43：胸椎の側方向断層撮影像では，椎体後側と胸椎上中部の後縦靭帯骨化症との間に線形の放射線透過部（矢印）が認められる．　図4．症例29：胸椎の側方向断層撮影像では，黄色靭帯骨化症（鏃）と後縦靭帯骨化症（矢印）との混合型が認められる．　図5．症例38：胸腰椎の側方向断層撮影像では，分節橋状後縦靭帯骨化症（矢印）がT12—L1とL2—3の椎間腔の後側に認められる．椎体前方に中等度の骨化（強直性脊椎過骨症）も認められる．

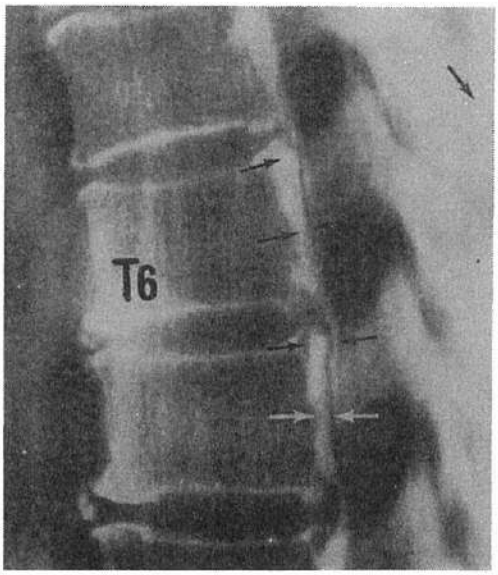


Figure 6. Case 13: Lateral thoracic spine tomogram shows laminated ossification of upper mid-thoracic PLLO (arrows).
図6. 症例13：胸椎の側方向断層撮影像では，胸椎上中部に層状骨化（矢印）が認められる．

TABLE 3 ASSOCIATED RADIOLOGICAL ABNORMALITIES IN 55 THORACIC PLLO CASES
表3 55例の胸椎後縦靭帯骨化症と関連のある放射線学的異常

Abnormality	Female (%)		Male (%)	
Cervical and lumbar PLLO				
Cervical PLLO	11/41	(27%)	3/7	(43%)
Lumbar PLLO	9/43	(21)	4/9	(44)
Cervical spondylosis	17/38	(45)	2/9	(29)
Mild	6		1	
Moderate	9		1	
Marked	2		0	
Ankylosing spinal hyperostosis				
Cervical spine	4/39	(10)	7/7	(100)
Thoracic spine	7/46	(15)	8/9	(89)
Lumbar spine	7/42	(17)	8/9	(89)
Degenerative abnormality, thoracic spine	30/46	(65)	5/9	(56)
Mild	22		4	
Moderate	5		1	
Marked	3		0	
Ligamentum flavum ossification	14/39	(36)	4/7	(57)
Ligamentum nuchae ossification	7/40	(18)	3/7	(43)
Ligamentum supraspinale ossification	0/39	(0)	2/7	(29)

Denominators vary because of number of body sites examined and radiographic projections used.
検査した部位及び使用した撮影方向の件数によって分母が異なる．

involvement; and in 15/51 cases (29%) with lumbar involvement. Nearly all of the male thoracic PLLO cases had accompanying ankylosing spinal hyperostosis in the cervical, thoracic, and lumbar regions (100%, 89% and 89%, respectively). The frequency of female thoracic

（27%），腰椎では15／51例（29%）に認められた．胸椎後縦靭帯骨化症を有する男性のほとんどには頚椎，胸椎及び腰椎部に強直性脊椎過骨症（それぞれ100%，89%，及び89%の割合）が認められた．女性における

PLLO cases with ankylosing spinal hyperostosis was much lower than reported elsewhere. Thoracic PLLO occurred with ligamenta flava ossification in 18/46 cases (39%) (Table 3), with ligamentum nuchae ossification in 10/47 cases (21%), and with supraspinous ligament ossification in 2/46 cases (4%). In males, thoracic PLLO may be associated with the ossifying diathesis.

Demonstration of Marked Thoracic PLLO in Both Sexes

Two cases (Cases 32 and 8) exemplify this degree of involvement:

CASE 32. This 58-year-old male, had extensive continuous cervical PLLO from C1 to C7 (Figure 7A), laminated at C6-7, and associated with marked ankylosing spinal hyperostosis anteriorly. In the upper mid-thoracic regions, the PLLO was bridge-type; thick at T4-5, and thin at T5-6, T6-7, T7-8, and T8-9. Minimal ankylosing spinal hyperostosis was noted anterior to T8-9. The thick continuous linear lower thoracic and lumbar PLLO was associated with ligamenta flava ossification at T10-11 and T11-12 (Figure 7B,C). There was extensive ossification in the ligamentum supraspinale and moderate anterior lumbar ankylosing spinal hyperostosis (Figure 7C). Computed tomography (CT) clearly revealed the degrees of occlusion of the spinal canal in the cervical, thoracic, and lumbar regions (Figure 7D,E,F).

CASE 8. This 55-year-old female, had continuous PLLO from C2 to C3, with a linear radiolucency between the ossification and the body of C2. The ossification was attached to the posterior aspect of the body of C3. The bodies of C5 and C6 were minimally deformed. There was minimal narrowing of the adjacent intervertebral spaces, and ligamentum nuchae ossification (Figure 8A). In the upper mid-thoracic regions, the PLLO was thick, combined type from T3 to T6, and thin at T9 and T10. There was ligamenta flava ossification at T10-11, T11-12, L1-2, and L2-3 (Figure 8B,C,D). In spite of the degree of PLLO, anterior ossification was minimal in this female case.

Neurological Manifestations of Thoracic PLLO

The results of the complete neurological

強直性脊椎過骨症を伴う胸椎後縦靭帯骨化症の頻度は，報告されているものよりも相当低い．胸椎後縦靭帯骨化症と黄色靭帯骨化症との併発は18／46例（39%）（表3），項靭帯骨化症とは10／47例（21%），また棘上靭帯骨化症とは2／46例（4%）の頻度で発現している．男性においては，胸椎後縦靭帯骨化症は骨化性素因と関連があるかもしれない．

男女における顕著な胸椎後縦靭帯骨化症の例示

顕著な骨化の例として，次の2例（症例32及び8）を示す：

症例32：この58歳の男性は，第1から第7頚椎にかけて広範囲に連続した頚椎後縦靭帯骨化症があり（図7A），第6－7頚椎で層化しており，前部に強直性脊椎過骨症があった．胸椎上中部では，後縦靭帯骨化症は橋構造を示し，第4－5胸椎では肥厚し，第5－6，第6－7，T7－8及び第8－9胸椎では菲薄していた．第8－9胸椎の前方には軽度の強直性脊椎過骨症が認められた．胸椎下部及び腰椎における厚い連続した線形の後縦靭帯骨化症は，第10－11及び第11－12胸椎で黄色靭帯骨化症を伴っていた（図7BとC）．棘上靭帯に広範な骨化症，及び前腰部に中等度の強直性脊椎過骨症が認められた（図7C）．CTにより頚椎，胸椎，及び腰椎における脊柱管狭窄の程度が確認された（図7D－F）．

症例8：この55歳の女性には，第2から第3頚椎に連続性の後縦靭帯骨化症があり，第2頚椎の椎体と骨化部との間に線形透過部が認められた．この骨化は第3頚椎の後部と付着していた．第5－6頚椎体は軽度に変形しており，隣接する椎間腔に軽度の狭少，及び項靭帯骨化症がみられた（図8A）．胸椎上中部における後縦靭帯骨化症は，第3から第6胸椎にかけては厚い混合型であったが，第9から第10胸椎においては菲薄していた．第10－11及び第11－12胸椎，第1－2及び第2－3腰椎では黄色靭帯骨化症が認められた（図8B－D）．後縦靭帯骨化の度合にかかわらず，この女性では前方の骨化は軽微であった．

胸椎後縦靭帯骨化症の神経学的所見

表4に，41例の患者について行った完全な神経学的

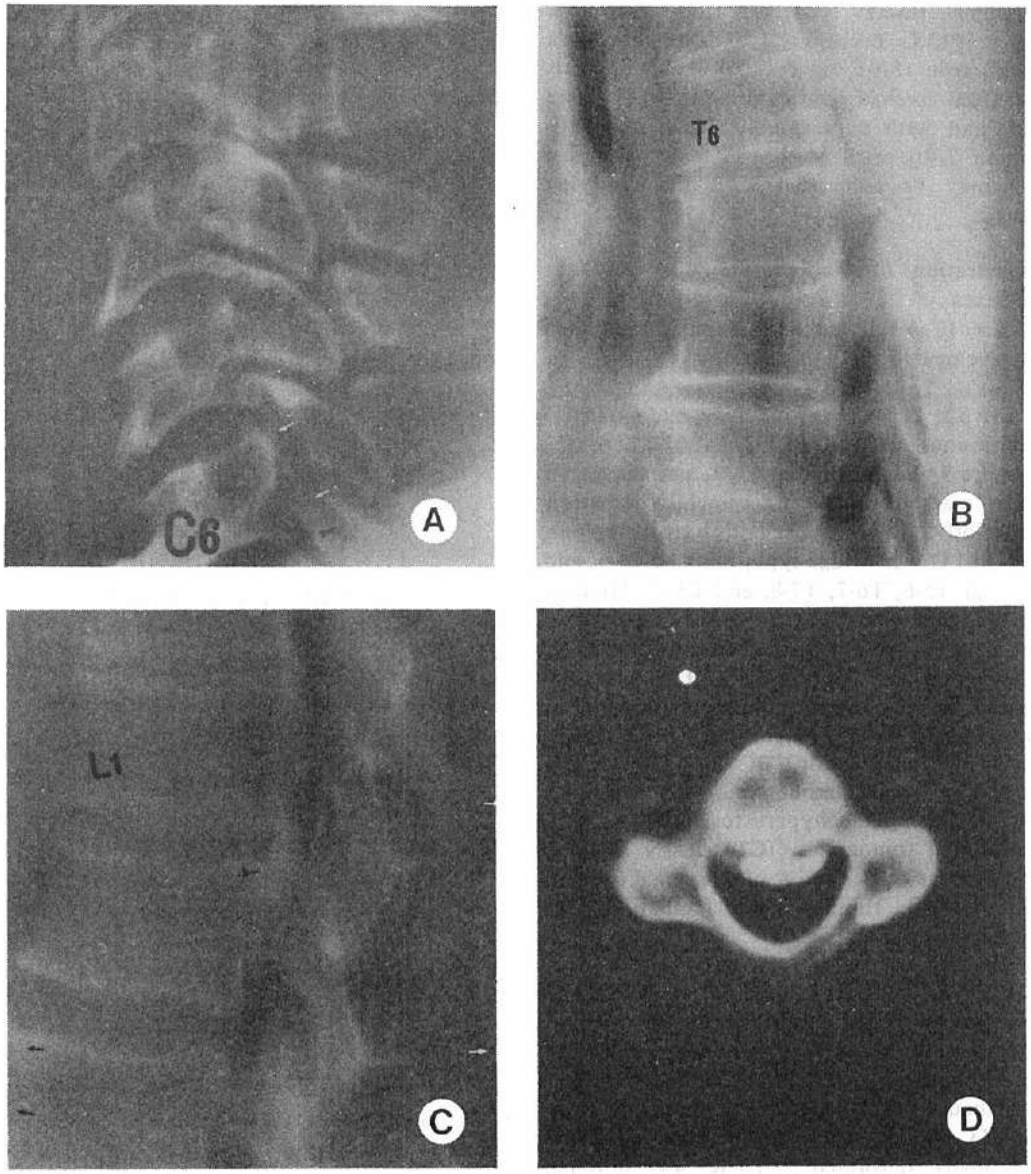


Figure 7. Case 32: (A) Lateral cervical spine radiograph shows continuous PLLO (arrow heads) with double PLLO plaques at C6 and C7 (arrows). Marked ankylosing spinal hyperostosis is also present. (B) Lateral thoracic tomogram shows a thick bridge-like PLLO segment at the posterior aspects of the intervertebral space at T4-5, & bridge-like PLLO segments at T5-6, T6-7, T7-8, and T8-9. Along the anterior aspect there is also a bridge of ossification (ankylosing spinal hyperostosis). (C) Lateral lumbar tomogram shows continuous linear PLLO (arrow heads) along the posterior aspects of vertebrae from T11 to L2. Ankylosing spinal hyperostosis (arrows) & ossified supraspinous ligament (arrows) are also present. (D) Computed tomography section made at the level of C2 clearly shows marked ossification of the PLLO. (E) Computed tomography section made at T5 shows ossification of the posterior longitudinal ligament and approximately 40% occlusion of the spinal canal. (F) Computed tomography section at the level of L1 shows clearly the PLLO.

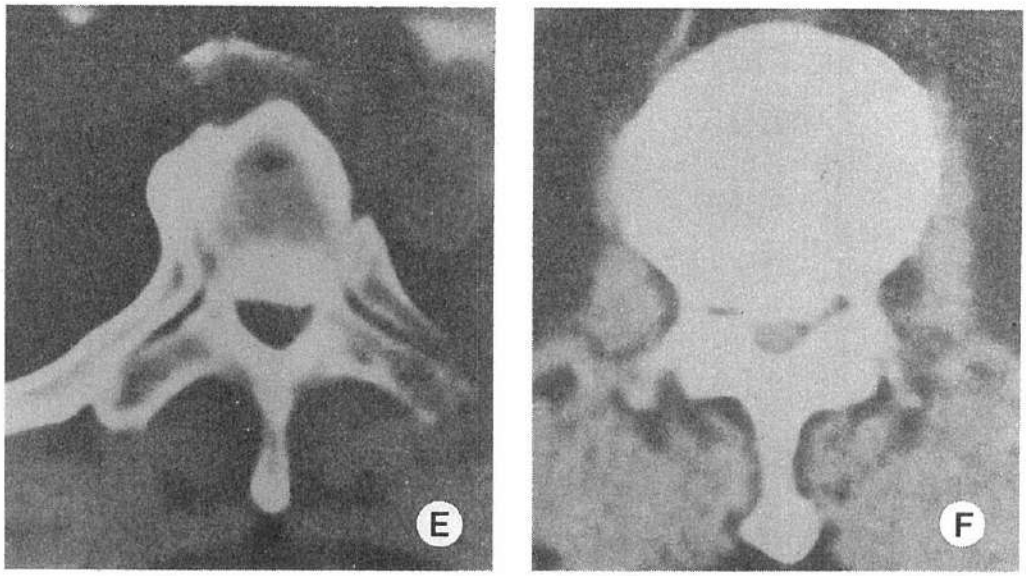


図7．症例32：（A）頚椎の側方向撮影像では，連続性の後縦靭帯骨化症（鏃）並びに第6－7頚椎（矢印）における二重の後縦靭帯骨化性斑が認められる．また，著明な強直性脊椎過骨症も認められる．（B）胸椎の側方向断層撮影像では，第4－5胸椎の椎間腔の後側に厚い橋状の後縦靭帯骨化症の部分が認められ，第5－6，第6－7，第7－8，第8－9胸椎に橋状の後縦靭帯骨化症の部分が認められる．前面には橋状の骨化（強直性脊椎過骨症）も見られる．（C）腰椎の側方向断層撮影像では，第11胸椎－第2腰椎の椎骨後方に連続性の線形後縦靭帯骨化症（鏃）が認められる．強直性脊椎過骨症（矢印）及び棘上靭帯骨化（矢印）も認められる．（D）第2頚椎におけるコンピューター断層撮影断面像では，後縦靭帯骨化症の著明な骨化が認められる．（E）第5胸椎におけるコンピューター断層撮影切断像では，後縦靭帯骨化症及び脊柱管の約40%が狭窄されている状態が認められる．（F）第1腰椎におけるコンピューター断層撮影断面像では，後縦靭帯骨化症が明白に認められる．

examinations received by 41 patients are shown in Table 4. Thoracic PLLO reportedly causes paraplegia and marked radiculomyelopathy, including spasticity and disordered sensory levels. However, most of our cases were asymptomatic or had only minimal neurological abnormalities, such as decreased ranges of motion of the spine, rather than myelopathy or radiculopathy (Table 5).

Radiological-neurological Correlation of 41 Cases

Many of our patients with thoracic PLLO had cervical spondylosis, making difficult at times to determine which of the two abnormalities was causing neurological problems. The degrees of the abnormalities detected radiologically and neurologically did not correlate well. The radiculopathy of three patients (Cases 1, 45 and 49) was due to cervical spondylosis or other causes rather than thoracic PLLO. Another patient (Case 48) had neurological evidence of cervical and lumbar radiculopathy, but there was

診察の結果を示す．胸椎後縦靭帯骨化症は対麻痺をもたらし，また痙攣及び感覚障害などの著しい神経根脊髄症の原因となると報告されている．しかし，症例のほとんどは脊髄や神経根症状はなく無症候性であったか，又は脊柱可動範囲の減少のような軽微な神経学的異常が認められたにすぎなかった（表5）．

41例における放射線学的所見と神経学的所見との相関

胸椎後縦靭帯骨化症を有する本調査対象の多くに頚椎脊椎症も認められ，この二つの異常のいずれが神経学的所見の原因であるかを決定することは，場合によって困難であった．放射線学的及び神経学的に認められたそれぞれの異常の度合には，よい相関がみられなかった．3例の神経根症（症例1，45と49）は，胸椎後縦靭帯骨化症よりもむしろ頚椎脊椎症，又は他の原因によるものであった．別の1例（症例48）には頚椎及び腰椎に神経根症の神経学的徴候が認め

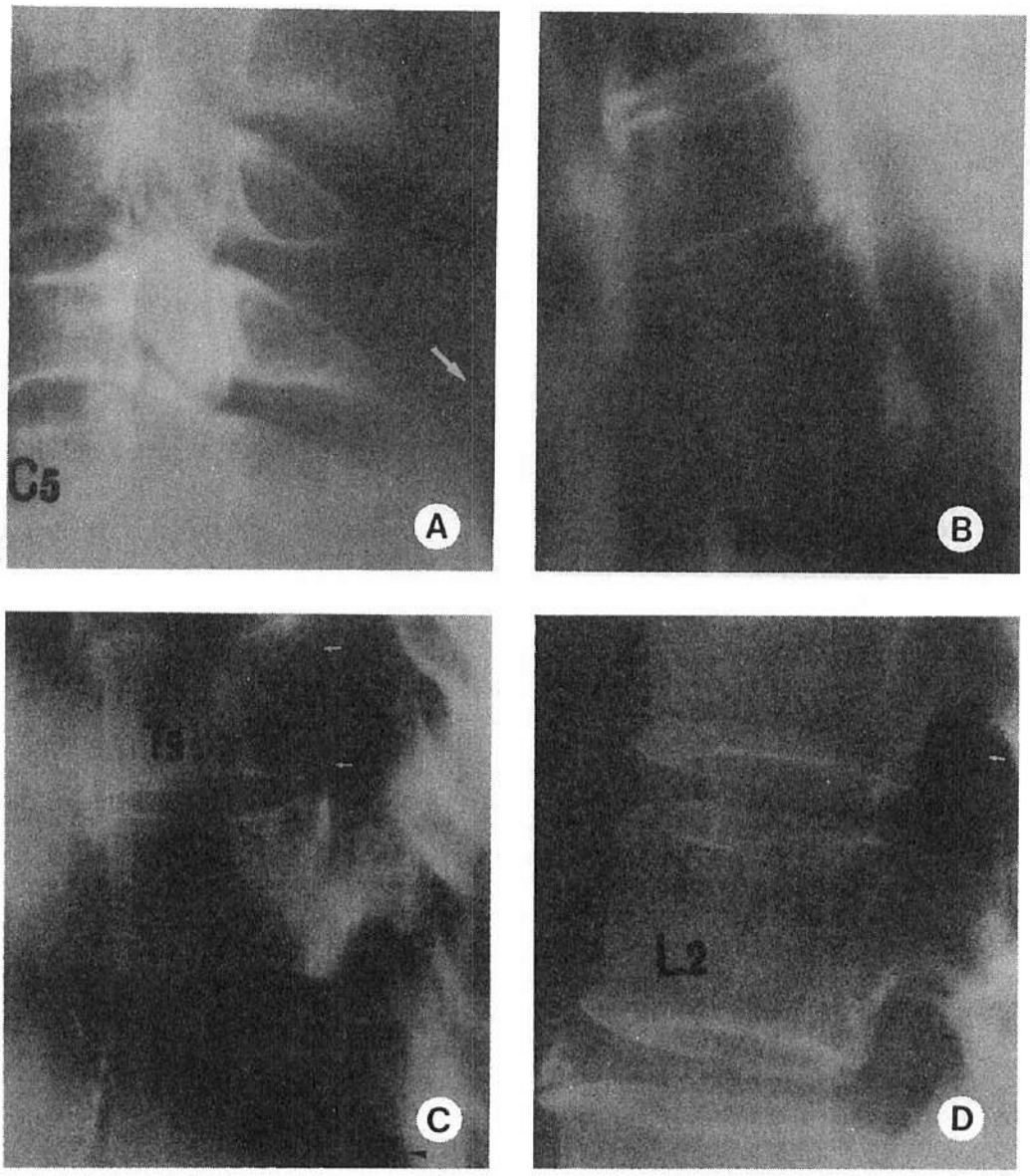


Figure 8. Case 8: (A) Lateral cervical spine tomogram shows continuous PLLO from C2 to C3, with attachment to the posterior aspect of C3. Ligamentum nuchae ossification is also present (arrows). (B) Lateral thoracic tomogram shows a thick combined-type PLLO from T3 to T6. (C) Lateral tomogram shows thin PLLO at T9 and T10 (arrows) with ligamenta flava ossification at T10-11 and T11-12 (arrow heads). Minimal ossification anterior to T8 and at T9-10 is also seen (ankylosing spinal hyperostosis). (D) Lateral lumbar tomogram shows thin linear ossification in the projection of the intervertebral foramina at L1-2 and L2-3 (arrows) indicating ligamenta flava ossification.

図8．症例8：（A）頚椎の側方向断層撮影像では，第2－3頚椎に連続性の後縦靭帯骨化症及び第3頚椎の後面への付着が認められる．項靭帯骨化症（矢印）も認められる．（B）胸椎の側方向断層撮影像では，第3－6胸椎に厚い混合型の後縦靭帯骨化症が認められる．（C）側方向断層撮影では，第9－10胸椎（矢印）に薄い後縦靭帯骨化症，また第10－11及び第11－12胸椎（鏃）に黄色靭帯骨化症が認められる．第8及び第9－10胸椎前方にも軽度の骨化が認められる（強直性脊椎過骨症）．（D）腰椎の側方向断層撮影像では，第1－2及び第2－3腰椎（矢印）の椎間孔の突起に薄い線形の骨化が認められる．これは黄色靭帯骨化症である．

TABLE 4 NEUROLOGICAL FINDINGS IN 41 THORACIC PLLO CASES

表4　41例の胸椎後縦靭帯骨化症における神経学的所見

Case No.	Master File No.	Sex	Age yrs	Neck		Extremities hyperreflexia		Other symptoms and signs	Clinical diagnosis		Remarks
				Limited movement	Pain	Upper	Lower		M	R	
1		F	61	+	+	–	–	Occipitalgia, Spurling's sign (+++), Lumbago, Lasegue's sign (Rt.)	–	+	
2		F	47	–	–	–	–	None	–	–	Neurologically normal
3		F	55	–	–	–	–	Lumbago, Scapular pain			Neurologically normal
4		F	53	+	+	–	+++	Spurling's sign	+	+	
5		F	67	+	++	++	+++	Lumbago Spurling's sign	+	+	
6		F	54	+	–	–	–	None	–	–	Asymptomatic Neurologically normal
7		F	75	–	–	–	+(R)	Patrick's sign, Lumbago	+	–	
8		F	55	–	–	–	–	None	–	–	Asymptomatic Neurologically normal
9		F	77	–	–	++ Below triceps (C7)	+++	Occipitalgia on neck movement	+	–	
10		F	71	+	–	++	+		+	–	
15		M	67	+	–	–	–	Lumbago, Shoulder discomfort, Sciatica	–	–	Sciatica, right
16		F	71	+	–	–	–	Neuralgic pain, right lower extremity	–	–	Rigid spine
18		F	59	–	–	–	–	Backache	–	–	Rigid spine
19		F	47	–	–	+	+	Neck pain, Low back pain Scoliosis	+	–	
20		F	57	–	–	–	–	Shoulder pain	–	–	Neurologically normal
21		F	59	–	–	+	+	Backache Shoulder discomfort Patrick's sign, left	+	–	
24		F	70	+	–	–	+(L)	Low back pain Patrick's sign	+	–	
25		F	76	+	–	+	+	Gait disturbance Stooped posture	–	–	Parkinsonism
26		F	64	–	–	–	+(L)	Shoulder discomfort	+	–	
28		F	69	–	–	–	+	Shoulder pain, Lumbago	+	–	
29		F	52	–	–	–	–	Mild lumbago	–	+	
30		F	63	–	–	–	–	None	–	–	Asymptomatic Neurologically normal
31		F	84	–	–	–	+++(R)	Dysarthria Neck tremor, Lumbago Small step gait	+	–	
32		M	58	+	–	–	–	Rigid spine	–	–	Asymptomatic Neurologically normal
35		M	52	+	–	–	–	Monoplegia, right lower extremity	–	–	Sequelae of poliomyelitis
36		F	53	+	+	+(R)	+(R)	Rigid spine, Lumbago	+	–	
37		F	63	+	+	++	+	Spurling's sign Hemihypesthesis (R) Sciatica	+	+	
38		M	58	+	+	–	–	Lumbago	–	–	Neurologically normal
39		F	72	+	–	–	–	Babinski (R)	+	–	
40		M	79	+	–	–	–	None	–	–	Rigid spine
41		M	52	–	–	+	+	Low back pain Patrick's sign, right	+	–	
42		F	69	–	–	–	–	Shoulder stiffness	–	–	Neurologically normal
43		F	74	–	–	–	–	Mild lumbago	–	–	Neurologically normal
44		F	50	–	+	–	–	Neuralgic pain along right arm	–	–	Neurologically normal
45		F	53	–	–	–	–	Lumbago, sciatica	–	+	
46		F	49	–	–	–	–	None	–	–	Neurologically normal
47		F	58	–	–	–	–	Mild lumbago	–	–	Neurologically normal
48		F	48	–	+	–	–	Sensory deficit mainly in roots C5-6 distribution Hyporeflexia, Lumbago	–	+	
49		F	47	–	–	–	–	Back pain, sciatica	–	+	Congenital cataract & nystagmus
51		M	52	–	–	+	+	Left-hemiparesis & dysarthria	–	–	Residuals of CVA with symptomatic epilepsy
54		F	58	+	+	–	–	Occipitalgia Shoulder stiffness Lumbago Paresthesia in hands, forearms, & toes	–	+	

M: Myelopathy 脊髄症　　R: Radiculopathy 神経根症

TABLE 5 NEUROLOGICAL FINDINGS IN 41 THORACIC PLLO CASES (MALE 7, FEMALE 34), SUMMARY

表 5　41例の胸椎後縦靭帯骨化症における神経学的所見（男性 7 例，女性34例），総括

Symptoms:	Low back pain	20
	Sciatica	3
	Occipitalgia	3
	Shoulder stiffness	7
	Other	7
	No symptoms	7
Signs:	Neck limitation of movement	17
	Neck pain on movement	9
	Spurling's sign	5
	Patrick's sign	4
	Laseque's sign	1
	Rigid spine	12
	Back pain in movement	6
	Deep tendon reflexes: Hyperactive in upper limbs	10
	Hyperactive in lower limbs	16
	Normal	25
	Babinski's sign	0
	Weakness	1*
	Sphincter disturbance	0
	Sensory disturbance: Hemihypesthesia, mild	7
	Sensory level	0
	Paresthesia	1
	Sensory deficit (C5, 6)	1
	Gait disturbance	2**
Clinical diagnosis:	Myelopathy	12
	Radiculopathy	6
	Myelopathy + radiculopathy	3
	Rigid spine only	3
	Neurologically normal	13
	Others	4***

Note: No case had marked radiculo- and/or myelopathy.

注　著明な神経根症や脊髄症はなかった．

No case had definite neurological evidence of involvement at thoracic levels.

胸椎に明確な神経学的障害のある例はなかった．

* Cerebrovascular accident (CVA) 脳血管障害

** Small step gait, spasticity in lower limbs. 歩幅が短かく，下肢に痙攣

Parkinsonism Parkinson 病

*** Sequelae of poliomyelitis, parkinsonism, sciatica, residuals of CVA

灰白髄炎，Parkinson 病，座骨神経痛，CVA 後の状態

no radiographic evidence of cervical or lumbar PLLO or cervical spondylosis. Thoracic PLLO could not be excluded as the cause of the neurological findings in 17 cases. However, there were no marked spinal cord disorders such as paraplegia, demarcated sensory levels, girdle sensations, or marked spasticity. There was no neurological evidence of spinal cord involvement at the thoracic levels.

Cervical and Lumbar PLLO

During the present study, four persons with cervical PLLO, two with lumbar PLLO, and one

られたが，頸椎又は腰椎の後縦靭帯骨化症や頸椎脊椎症の放射線学的所見は認められなかった．残り17例の神経学的所見の原因として，胸椎後縦靭帯骨化症を除外できなかった．しかし対麻痺，限局性知覚障害，帯状感覚又は著明な痙攣のような著しい脊髄障害はなかった．胸椎レベルでの脊髄障害の神経学的徴候は認められなかった．

頸部及び腰部の後縦靭帯骨化症

本調査中，頸椎後縦靭帯骨化症 4 例，腰椎後縦靭帯骨化症 2 例，頸椎及び腰椎後縦靭帯骨化症の

TABLE 6 ASSOCIATED RADIOLOGICAL MANIFESTATIONS OF PLLO IN THE CERVICAL AND LUMBAR REGIONS

表 6　頚椎及び腰椎の後縦靭帯骨化症と関連のある放射線学的所見

Case	MF No.	Sex	Age	ASH				DA in T-spine	LNO	LFO	Other
				C-spine	T-spine	L-spine	CS				
56	[redacted]	M	77	++	+++	++	++	+	+	–	Ossified supraspinous ligament
57		M	48	+	++	++	+	–	–	–	Compression fracture (L1)
58		M	51	+	+++	+	.	+	–	.	
59		M	87	+	+++	+++	–	++	–	–	
60		F	59	–	–	–	+	–	–	–	
61		M	50	–	+	+++	+	–	–	–	
62		M	42	–	–	.	+	–	–	–	

ASH = ankylosing spinal hyperostosis 強直性脊椎過骨症
CS = cervical spondylosis 頚椎脊椎症
DA = degenerative abnormalities 退行性変化
LNO = ligamentum nuchae ossification 項靭帯骨化症
LFO = ligamentum flavum ossification 黄色靭帯骨化症

\+ Minimal 微少
++ Moderate 中等度
+++ Marked 著明
. No examination 検査を受けなかった者
– Negative 陰性

TABLE 7 NEUROLOGICAL FINDINGS IN PLLO OF THE CERVICAL AND LUMBAR REGIONS

表 7　頚椎及び腰椎の後縦靭帯骨化症における神経学的所見

Case	MF No.	Age	Sex	Neck		Extremities hyperreflexia		Other symptoms and Signs	Clinical Diagnosis		Remarks
				Limited movement	Pain	Upper	Lower		M	R	
56	[redacted]	76	M	+	–	–	–	Lumbago	–	–	Neurologically normal
57		49	M	–	+	–	+(L)	Spurling's sign Lumbago	+	+	
59		87	M	+	–	–	–	None	–	–	Asymptomatic Neurologically normal
60		59	F	–	+	–	–	Spurling's sign Lumbago Hyporeflexia Sensory deficit mainly in root S1 distribution Pathologic reflex (+)	+	+	Cervical and lumbar radiculomyelopathy
61		50	M	+	+	–	–	Low back pain Spurling's sign	–	+	

M = myelopathy 脊髄症
R = radiculopathy 神経根症
(L) = (Left) 左

with both cervical and lumbar involvement were encountered. None of these had thoracic PLLO. The sites involved by PLLO, and the associated radiological and neurological findings are summarized in Tables 6 and 7, and in Figure 9.

Any tendency of PLLO to occur in high A-bomb radiation dose groups was investigated,[22] but no correlation with dose was seen.

ある者1例が認められた．このうち，胸椎後縦靭帯骨化症を有する者は1例もなかった．後縦靭帯骨化症の部位並びにそれに関連のある放射線学的及び神経学的所見については，表6，7及び図9に要約した．

高線量の原爆放射線被曝者における後縦靭帯骨化症発現の傾向について調べたが，[22] 被曝線量との関係は認められなかった．

FIGURE 9 RADIOLOGICAL MANIFESTATIONS OF PLLO IN THE CERVICAL AND LUMBAR REGIONS
図 9　頚椎及び腰椎の後縦靭帯骨化症における放射線学的所見

Case No.	Master File No.	Sex	Age yrs	Site Involved at Last Radiography																			
				C1	C2	C3	C4	C5	C6	C7	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11	T12	L1	L2	L3	L4	L5
56		M	77																			20				
57		M	48																			35				
58		M	51		30																					
59		M	87				47																			
60		F	59			33																26				
61		M	50			29																				
62		M	42																			No exam.				

Numbers indicate the maximum percent occlusion of the spinal canal due to PLLO by site in all cases for whom tomography was performed.
数字は，後縦靭帯骨化症による脊柱管狭窄の最大百分率を，断面撮影を行った全例について部位別に示したものである．

DISCUSSION

Some may question the classification of PLLO in the cervical, thoracic, and lumbar. In the present study PLLO was first scrutinized in the thoracic region, then other sites were examined. Thoracic PLLO was classified morphologically as bridge, linear, or combined. The bridge-type ossification must be differentiated from the osteophytes at the posterior margins of the vertebrae, and from calcified herniated disks. In some cases, this was difficult. CT should be useful in evaluating such cases.

Most PLLO reportedly involves the cervical region; there are few reports of thoracic PLLO.[13-20,23,24] Thoracic PLLO has not yet been systematically investigated. The published reports of thoracic PLLO are summarized in Table 8. Some of these investigators reported thoracic and lumbar PLLO as the same category. The documented cases of thoracic PLLO were apparently those of marked degree, accompanied by ligamenta flava ossification, and ankylosing spinal hyperostosis during examinations of patients with cervical PLLO and radiculomyelopathy. Thoracic PLLO is likewise regarded a serious entity. However, in the present 41 thoracic PLLO cases neurologically examined, no case had marked radiculo- and/or myelopathy, and no definite neurological evidence of involvement at thoracic levels. Thus, thoracic PLLO is not always a serious problem.

考　察

後縦靭帯骨化症を頚椎，胸椎，及び腰椎とに分類することに疑問を抱く研究者がいるかもしれない．本調査では，最初に胸椎の後縦靭帯骨化症を詳細に調査し，その後他の部位について調べた．胸椎後縦靭帯骨化症は形態的に橋状，線形，両者の混合型に分類した．橋状型骨化症は，脊椎の後縁部の骨増殖体及び石灰化した脱出椎間板と識別しなければならない．幾つかの症例ではこれが困難であった．このような症例を評価するのには CT は有効と考えられる．

後縦靭帯骨化症のほとんどは頚椎に発現し，胸椎には少ないと報告されている．[13-20, 23, 24] 胸椎後縦靭帯骨化症は，現在のところまだ系統的に調査されていない．胸椎後縦靭帯骨化症に関する報告の概要は表 8 に示す．これらの研究者の中には，胸椎及び腰椎後縦靭帯骨化症を一つの範疇に含めて報告しているものもいる．記述されている胸椎後縦靭帯骨化症例は著明なもので，頚椎後縦靭帯骨化症及び神経根脊髄症を有する患者の検診中に，黄色靭帯骨化症及び強直性脊椎過骨症を伴っていたものと思われる．したがって胸椎後縦靭帯骨化症もまた重篤な疾患とみなされている．しかし本調査では，41例の胸椎後縦靭帯骨化症を神経学的に検診を行ったが，著明な神経根症ないし骨髄症を発現した症例はなく，また，胸椎骨化を示唆する明らかな神経学的徴候も認められなかった．したがって，胸椎後縦靭帯骨化症は常に重篤な問題であるとは限らない．

TABLE 8 PREVIOUS REPORTS OF POSTERIOR LONGITUDINAL LIGAMENT OSSIFICATION IN THE THORACIC OR THORACOLUMBAR SPINE

表 8　胸部又は胸腰部脊椎の後縦靭帯骨化症に関する以前の報告

Author, Year	Case		PLLO		LFO	ASH			Neurological abnormality	
	Male	Female	C-spine	L-spine		C-spine	T-spine	L-spine	M	R
Tsuchiya,[14] 1975	5 (26%)	14 (74%)	12 (63%)	*	3 (16%)		7 (34%)		-	-
Tezuka,[15] 1976	3 (23)	10 (77)	11 (85)	8 (62%)	3 (19)	-	8 (62)	-	9 (69%)	2 (15%)
Maehara,[16] 1977	6 (26)	17 (74)	16 (70)	*	14 (61)		5 (22)		17 (74)	
Yanagi,[20] 1977	7 (35)	13 (65)	17 (85)	*	11 (55)	5 (25%)		13 (65%)	19 (95)	
Imai,[17] 1977	5 (21)	19 (79)	13 (54)	8 (33)	-	-		15 (63)	16 (67)	
Murakami,[18] 1977	2 (11)	17 (89)	9 (47)	4 (21)	-	-	-	-	12 (50)	
Ohtani,[19] 1977	1 (10)	9 (90)	6 (60)	-	3 (30)	-	-	-	7 (70)	

PLLO = posterior longitudinal ligament ossification 後縦靭帯骨化症
LFO = ligamenta flava ossification 黄色靭帯骨化症
ASH = ankylosing spinal hyperostosis 強直性脊椎過骨症
M = myelopathy 脊髄症
R = radiculopathy 神経根症
*Thoracic PLLO and lumbar PLLO were included in one category.
胸椎後縦靭帯骨化症と腰椎後縦靭帯骨化症を一つにまとめてある.
- No remarks 特記事項なし

All PLLO lesions in the present study were detected by lateral chest radiography among members of a fixed population who were for the most part asymptomatic. This is the first report of the prevalence of thoracic PLLO by decade in a fixed population sample. Compared with cervical PLLO, having a frequency of 1%-3% in those with cervical symptoms, thoracic PLLO is reportedly rare. It is not truly rare (Table 1), however, and thoracic PLLO was predominant among females by a factor of three, nearly to the same extent as reported by other investigators.

The reported frequency of thoracic PLLO accompanying cervical PLLO ranges from 47% to 85% (Table 8). Among 2,162 Japanese PLLO cases, pure thoracic PLLO without cervical or lumbar involvement is reportedly rare.[13] In the present study, however, there were 27 pure thoracic PLLO cases among a total of 48, and it was thus also not uncommon. Numerous reports of cervical PLLO among the Japanese point out that the degree of ossification and

本調査における後縦靭帯骨化症例のすべては，大部分が無症候性であった固定集団対象者について行った側方向胸部X線撮影で探知されたものである．本稿は，固定対象集団における10年間ごとの胸椎後縦靭帯骨化症の頻度に関する最初の報告書である．頸部に症状を呈する者における頸椎後縦靭帯骨化症の頻度が1％－3％であるのに比べ，胸椎後縦靭帯骨化症はまれであると報告されているが，実際にはそれ程まれなものではない（表1）．胸椎後縦靭帯骨化症は，女性の方が男性よりも3倍多く認められ，これは他の研究者が報告したものとほぼ同程度であった．

頸椎後縦靭帯骨化症を伴う胸椎後縦靭帯骨化症の頻度は，47％－85％であると報告されている（表8）．2,162名の日本人後縦靭帯骨化症例のうち，頸椎又は腰椎の骨化を伴わない純然たる胸椎後縦靭帯骨化症はまれであると報告されている．[13] しかし本調査では，全症例48例中，27例に純然たる胸椎後縦靭帯骨化症が認められたため，まれとは言えない．日本人の頸椎後縦靭帯骨化症に関する報告の多くは，骨化の

severity of symptoms do not always coincide. Nevertheless, the severity of symptoms depends to some extent on the sagittal diameter of the spinal canal and the thickness of the ossification. Though the numerical values of such cervical PLLO studies varied, the critical degree of occlusion by the ossification appeared to be 40%.[25-27]

There are few reports of correlation between the degree of thoracic PLLO and myelopathy. Ohtani et al[19] (Table 8) reported seven cases of ossification with myelopathy occluding 38%-60% of the sagittal dimensions of their spinal canals. Three of his asymptomatic cases had 25%, 25%, and 30% occlusions, respectively. With thoracic PLLO, the symptoms thus can increase in proportion to the degree of the occlusion by ossification. Ossification thicknesses of 3 of our 55 thoracic PLLO cases exceeded 40% of the sagittal dimensions of their spinal canals, but none had neurological abnormalities. In no case did the neurological findings indicate that the spinal cord was definitely involved at the thoracic levels. In the present study, the critical degree of occlusion by thoracic PLLO could not be ascertained, and further assessments of this point using CT are indicated.

Though various causes of PLLO have been proposed, its true etiology remains unknown. The features of the various kinds of spondylitis have been reviewed in detail, but they appear to be different from those of PLLO.[28] Among degenerative abnormalities, the local causes include trauma[1,29] and disk herniation.[30,31] The general factors reportedly influencing the development of PLLO are obesity, diabetes mellitus,[32-34] generalized degeneration,[29] fluorosis,[35] and a tendency towards hyperostosis.[5,11,29,31,36-38]

Cervical PLLO often accompanies ankylosing spinal hyperostosis or generalized hyperostosis, such as diffuse idiopathic skeletal hyperostosis.[39-42] Many Japanese investigators have therefore regarded PLLO as part of a general hyperostotic diathesis. Nearly all male cases in the present study having thoracic PLLO had ankylosing spinal hyperostosis, tending to support this concept (Table 8). However, only 7 of our 46 females with thoracic PLLO had thoracic ankylosing spinal hyperostosis. Thoracic PLLO was predominant among females, and its frequency did not increase with age after 40

程度と症状の重篤度とは常に一致するとは限らないことを指摘している．しかしながら症状の重篤度は，ある程度は脊柱管矢状径と骨化の厚さに依存する．このような頚椎後縦靭帯骨化症の数値には差異があるが，骨化による狭窄の限界度は40％であると考えられている．[25-27]

胸椎後縦靭帯骨化症の程度と脊髄症との相関に関する報告は少ない．大谷ら[19]（表8）は，脊柱管の矢状径が38％～60％狭窄されている7例の脊髄症を伴う骨化症例を報告している．無症候性の3例にはそれぞれ25％，25％，30％の狭窄があった．胸椎後縦靭帯骨化症においては，症状は骨化による狭窄率と比例して増悪するといわれる．しかし，本調査における55例の胸椎後縦靭帯骨化症例中，3例では骨化の厚さは脊柱管矢状径の40％以上であったが，そのいずれにも神経学的異常は認められなかった．またいずれの症例についても，神経学的所見からは，脊髄が胸椎部で明らかに障害を起こしていることを示すものはなかった．本調査では，胸椎後縦靭帯骨化症による狭窄の限界度は確認できなかったため，この点については今後CTを用いて評価を行う必要がある．

後縦靭帯骨化症については色々な原因が示唆されているが，真の病因はまだ不明である．各種の脊椎炎の特徴が詳細に検討されたが，それらは後縦靭帯骨化症のそれとは異なるようである．[28] 各種の退行性変化中，限局性のものとしては外傷[1,29]や椎間板ヘルニア[30,31]等がある．その発現に影響を及ぼす全身的な因子として報告されているものには，肥満，糖尿病，[32-34]全身性変性，[29] 弗素沈着症，[35] 及び全身性過骨化傾向がある．[5,11,29,31,36-38]

頚椎後縦靭帯骨化症はしばしば強直性脊椎過骨症，若しくは瀰漫性特発性全身性過骨症のような全身性過骨症を伴う．[39-42] したがって多くの日本の研究者は，後縦靭帯骨化症を全身性過骨性素質の一部と考えている．本調査では，胸椎後縦靭帯骨化症を有するほとんどの男性症例に強直性脊椎過骨症が認められ，これはこの概念を裏付けているように思われる（表8）．しかし女性では，胸椎後縦靭帯骨化症を有する46例のうち，強直性脊椎過骨症が認められたのはわずかに7例であった．胸椎後縦靭帯骨化症は女性の方により多く発現し，その頻度は40歳以降は

years. On the contrary, ankylosing spinal hyperostosis is predominant among males, and it increases rapidly after 60 years of age.[40–43] Sex is apparently important in determining whether PLLO occurs with ankylosing spinal hyperostosis or diffuse idiopathic skeletal hyperostosis. Therefore, it cannot be concluded that PLLO, especially thoracic PLLO, is a form of ankylosing spinal hyperostosis.

The present study indicated that thoracic PLLO 1) is not rare, especially when unaccompanied by the cervical and lumbar forms; 2) is predominant among females; 3) is infrequently associated with ankylosing spinal hyperostosis in females; and 4) does not usually cause symptoms, even when relatively marked in degree. These findings are in contrast to those of other investigators who detected cases in the "clinical" stage.

One hypothesis considered is that some yet unidentified factor, possibly endocrine, may precipitate the development of ankylosing spinal hyperostosis or diffuse idiopathic skeletal hyperostosis, more readily in males than females. Thoracic PLLO often develops along the vertical axis, without increasing in thickness, resembling a physiological process in aging.[43] Patients with this type of involvement could be expected to remain asymptomatic, without developing ankylosing spinal hyperostosis or diffuse idiopathic skeletal hyperostosis. However, if such a factor should become operative, the thoracic PLLO could increase in thickness, resulting in radiculomyelopathy, accompanied by cervical and/or lumbar PLLO and ankylosing spinal hyperostosis.

年齢と共に増加しなかった．これに対して強直性脊椎過骨症は男性に多く，60歳以降に急増した．[40–43] 後縦靭帯骨化症が強直性脊椎過骨症又は瀰漫性特発性全身性過骨症のいずれと併発するかを決定する上で，性は明らかに重要である．したがって後縦靭帯骨化症，特に胸椎後縦靭帯骨化症は強直性脊椎過骨症の一種であると結論することはできない．

本調査では，1) 胸椎後縦靭帯骨化症はまれな疾患ではない．特に，頚椎及び腰椎の骨化を伴わない時にそうである．2) 女性における発現が高い．3) 女性においては強直性脊椎骨化症を伴う頻度は低い．4) 比較的骨化の程度が重篤な場合でも通常症状を伴わない．以上の所見は，"臨床"段階で症例を探知した他の研究者らの場合と異なる．

一つの仮説としては，まだ確認されていないある内分泌性の因子が，女性よりも男性においてより容易に強直性脊椎過骨症，若しくは瀰漫性特発性全身性過骨症の発現を促進させているかもしれない．胸椎後縦靭帯骨化症は加齢の一つの生理学的現象のように，しばしば肥厚することなく垂直軸に沿って発現する．[43] このような骨化を有する症例は，強直性脊椎過骨症あるいは瀰漫性特発性全身性過骨症を起こすことなく，無症候性のまま経過することが考えられる．しかし，このような因子が活動性となった場合，胸椎後縦靭帯骨化が肥厚をきたし，頚椎ないしは腰椎後縦靭帯骨化症及び強直性脊椎過骨症を伴う神経根脊髄症となり得るのではないだろうか．

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