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Lumbar posterior marginal intra-osseous cartilaginous node

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Abstract. This report concerns 12 patients, eight young adults and four adolescents, presenting with lumbar or sciatic pain. This was associated with an unusual defect of the inferior and posterior edges of the vertebral bodies of L4 or L5, together with a small bony ridge protruding into the spinal canal. We found 11 similar cases in the literature, all involving adolescents except for one young adult.

It has been considered to be the result of a fracture of the posterior ring apophysis in association with a herniated disc. In our cases, in the absence of any known previous trauma, the radiological features and surgical results and the similarity and frequent association with typical lesions of Scheuermann disease, all suggest a posterior marginal cartilaginous node. The inferior lumbar location and frequent association with herniated disc and sciatic nerve root compression in young patients are discussed.

Key words: Spine, intervertebral discs – Scheuermann disease – Spine, computed tomography

In 1973, Lowrey first reported a cartilaginous and bony ridge protruding into the spinal canal at the L4–5 or L5–S1 level, causing nerve root compression in three teenagers operated on for sciatic pain [6]. The lesion was considered to be a traumatic dislocation of the posterior ring apophysis, carrying with it the edge of the cartilaginous plate and nucleus pulposus. Later observations by Keller [4], Lippitt [5], Handel et al. [2], and Techakapuch [9] raised to 11 (ten adolescents and one young adult) the number of reported cases and gave further radiological details. All the authors considered the lesion to be a traumatic posterior fracture of the secondary ossification center of the vertebral body. We report 12 cases of the same lesion in eight adults and four adolescents. We call it posterior bony avulsion (PBA) and discuss its physiopathology.

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Materials and methods

The 12 patients in this series were referred to the rheumatological, neurosurgical, or orthopedic departments for lumbar or sciatic pain from 1977 to 1984. All conventional lumbar radiographs and tomograms showed the specific picture described below in a lower lumbar vertebrae. Signs of Scheuermann disease were sought retrospectively in each case; however, thoracic spine radiographs were available in only three cases. Myelography was performed in five cases and a computed tomography (CT) scan in six. Six patients had surgery for sciatic pain.

Results

The present 12 cases (seven males and four females) are summarized in Table 1. Four were adolescents aged 17 to 18 years, and eight were young adults from 25 to 38 years. A definite previous history of lumbar trauma was never found. Clinical findings with diagnoses are recorded in Table 2. Six patients (50%) had unilateral (four cases) or bilateral (two cases) sciatic pain. The six other patients had low back pain without neurological involvement.

In all 12 cases, lateral lumbar films showed a similar lesion: a defect was present in the posteroinferior margin of the vertebral body of L4 (nine cases) or L5 (three cases). A bony ridge appeared posterior to the defect in the body and protruded into the spinal canal (Fig. 1). This bony fragment was either separated from the posterior body wall,

Table 1. Findings in the 12 patients of the present series

Case	Age (years) (sex)	Signs and symptoms	Trauma	Location	Radiological findings				Surgical findings
					Narrowing of disc space	Signs of Scheuermann disease	CT	Myelogram findings	
1	38M	Chronic low back pain	None	Inferior rim of L4	Moderate	Schmorl's nodes of L1, L2, L3	Posterior node of L4	Anterior epidural impression at L4–5 with 50% encroachment on the spinal canal	Bony ridge extending across the anterior spinal canal. Defect containing cartilaginous tissue in the inferior margin of L4
2	25M	Left sciatic pain. S1 motor loss	None	Inferior rim of L5	None	None (no thoracic spine radiographs)	Not done	Anterior epidural impression at L5–S1 with 50% encroachment on the spinal canal	Irregular posterior ligament. Bony ridge extending across the anterior spinal canal. Nests of cartilaginous tissue in the inferior margin of L5
3	17F	Chronic low back pain	Intensive ice-skating. No specific trauma	Inferior rim of L4	Moderate	Irregular vertebral plates. Numerous Schmorl's nodes. Thoracic kyphosis	Posterior node of L4. No disc herniation at L4–5	Not done	No surgical treatment
4	18M	Acute low back pain	None	Inferior rim of L4	Considerable	Irregular vertebral plates. Numerous Schmorl's nodes. Thoracolumbar kyphosis	Not done	Anterior epidural impression at L4–5 with 50% encroachment on the spinal canal	No surgical treatment
5	29F	Chronic low back pain	None	Inferior rim of L4	Considerable	Irregular vertebral plates. Numerous lumbar Schmorl's nodes	Not done	Not done	No surgical treatment
6	25M	Chronic low back pain	Gymnast. No specific trauma	Inferior rim of L4	Moderate	None (no thoracic spine radiographs)	Not done	Not done	No surgical treatment
7	17M	Left S1 sciatic pain	None	Inferior rim of L5	None	None (no thoracic spine radiographs)	Not done	Disc herniation not demonstrated	Lateral herniation of L5–S1 disc compressing the left L5 root in the foramen. Bony ridge not seen
8	28M	Right then bilateral sciatic pain (3 years duration)	None	Inferior rim of L4	Moderate	None (no thoracic spine radiographs)	Posterior marginal node of L4. Posterolateral disc herniation at L4–5	Not done	Lateral herniated disc at L4–5 compressing the right S1 nerve root. Bony ridge in the spinal canal

Table 1 (continued)

Case	Age (years) (sex)	Signs and symptoms	Trauma	Location	Radiological findings				Surgical findings
					Narrowing of disc space	Signs of Scheuermann disease	CT	Myelogram findings	
9	17F	Right sciatic pain	None	Inferior rim of L5	Moderate	Irregular vertebral plates. Numerous lumbar Schmorl's nodes	Posterior marginal node of L5. No disc herniation at L5–S1	Not done	No surgical treatment
10	29M	Left intermittent sciatic pain	None	Inferior rim of L4	Moderate	Numerous lumbar Schmorl's nodes	Arcuated bony ridge in the anterior spinal canal. Lateral disc herniation at L4–5	Not done	Herniated disc at L4–5 compressing the left L5 nerve root. Curettage of osteocartilagineous fragments
11	31F	Chronic low back pain	None	Inferior rim of L4	Moderate	None (no thoracic spine radiographs)	Not done	Not done	No surgical treatment
12	41M	Bilateral sciatic pain (3 years duration)	Fall from horse 28 years before (no X-rays)	Inferior rim of L4	Considerable	None	Posterior marginal node of L4. Posterior disc herniation at L4–5	Anterior epidural impression with 80% encroachment on the spinal canal	Considerable disc herniation at L4–5. Bony ridge not seen

Table 2. Comparison of present series and previous literature

	Number of cases	Sex		Age (in years)		Location			Trauma	Clinical symptoms			Reduced disc height	Radiological signs of Scheuermann disease
		M	F	13–18	25–28	L3–4	L4–5	L5–S1		Lumbar pain	Unilateral sciatic pain	Bilateral sciatic pain		
Present series	12	8	4	4	8	0	9	3	1	6	4	2	10[b]	6
References [2, 4, 5, 6, 9]	11	11	0	10	1	1	9	1	7[a]	2	4	5	NS[c]	NS[c]

[a] Type of trauma when stated: weight lifting [2, 5, 9] hyperextension injury [4]
[b] Reduced disc height is absent in two cases located at L5–S1
[c] NS = Not stated

or more often continuous at its superior end with the vertebral body. On frontal films, the lesion was situated in the midline and occupied approximately half the vertebral plate. It appeared as an irregularity of the subchondral bone with a dense sclerotic margin or it had a "honeycomb" appearance (Fig. 2) with several small lytic areas surrounded by a sclerotic rim. The bony ridge was not usually seen on the frontal view. All these lesions were visualized on conventional lumbar radiographs but were much better demonstrated on lateral and frontal tomograms. The height of the intervertebral space was normal in three cases (two L5–S1 and one L4–5) and reduced in nine cases (eight L4–5 and one L5–S1). In case 3, a 17-year-old girl, previous radiographs done for lumbar pain demonstrated the progressive nature of PBA (Fig. 3).

Radiological signs of Scheuermann disease

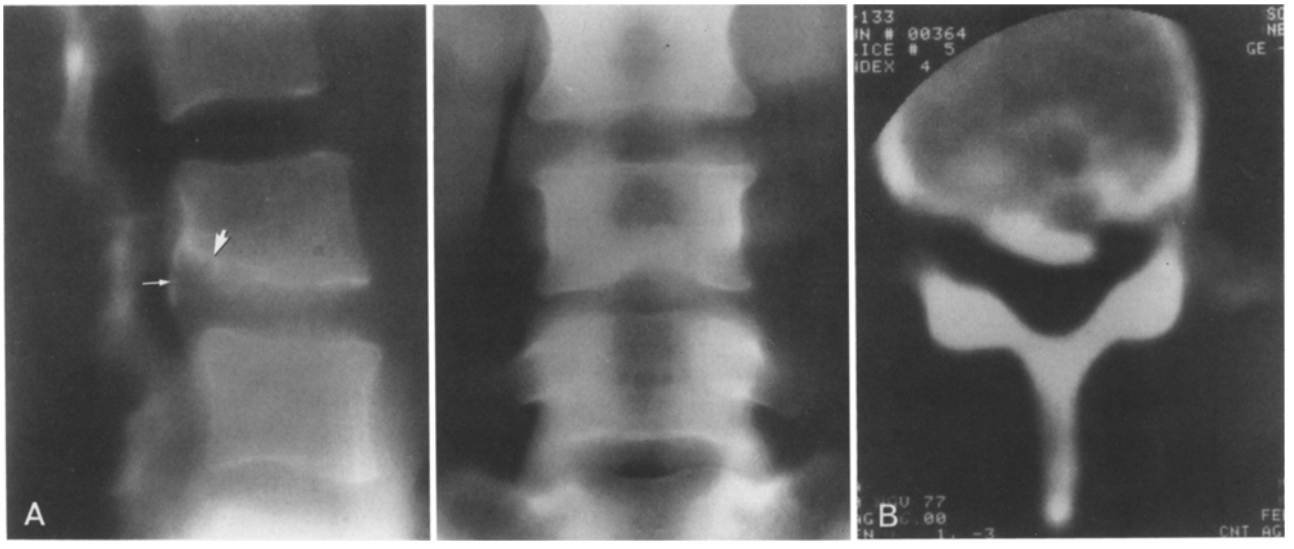

Fig. 1. *Case 1.* **A** Air myelography. Tomograms: Bony ridge extending across the anterior spinal canal (*arrow*). Defect of the postero-inferior edge of L4 with irregular sclerotic margins (*arrow-head*). Slight narrowing of the L4–5 disc space. Irregular midline erosion of the inferior plate of L4 on the frontal view. **B** CT: biloculated midline lytic zone with sclerotic limits in the posterior part of L4 body. Convex bony ridge protruding into the spinal canal

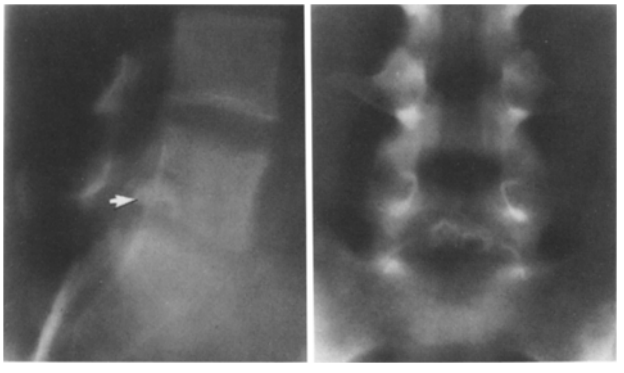

Fig. 2. *Case 2.* Air myelography. Tomograms: bony ridge with 50% encroachment on the spinal canal (*arrowhead*). "Honeycomb" appearance of L5 inferior margin on the frontal view

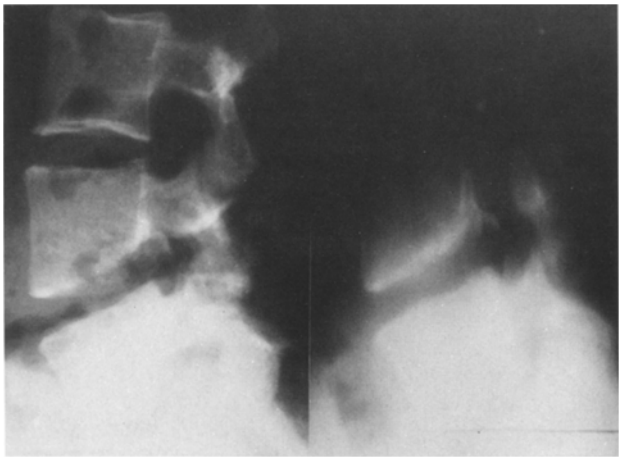

Fig. 3. *Case 3.* Lateral conventional X-ray film and tomogram in a girl aged 17 years practising intensive ice skating: a typical PBA is present at L4–5

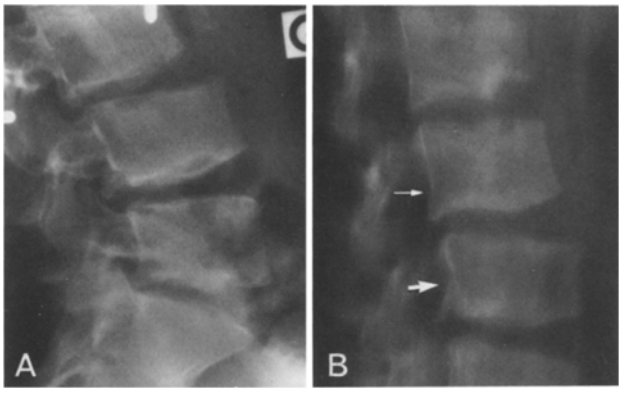

Fig. 4. *Case 4.* **A** Bony ridge in the anterior spinal canal at L4–5. Wedging of L4. Schmorl's nodes of the superior and inferior vertebral plates of L4. Disc space narrowing. **B** Abnormally protruding postero-inferior edge of L3 (*arrow*) similar to the posterior bony avulsion of L4 (*arrowhead*) but less pronounced. Angular kyphosis at L1-2 with vertebral body wedging. Schmorl's nodes and antero-inferior marginal disc herniation of L2

(SD) were obvious in six cases (50%). In cases 3, 4, and 9, SD was severe, with multiple giant lumbar Schmorl's nodes, wedging of the vertebral bodies, irregular vertebral plates, and kyphosis (Fig. 4); in case 4, a PBA of L4 was associated with an abnormal protruding postero-inferior edge of L3 similar to PBA but less pronounced (Fig. 4). In case 1, 5, and 10, SD consisted of multiple lumbar Schmorl's nodes without irregular plates or vertebral wedging. In cases 4 and 5, PBA and typical Schmorl's node coexisted in the same vertebral body (Fig. 4).

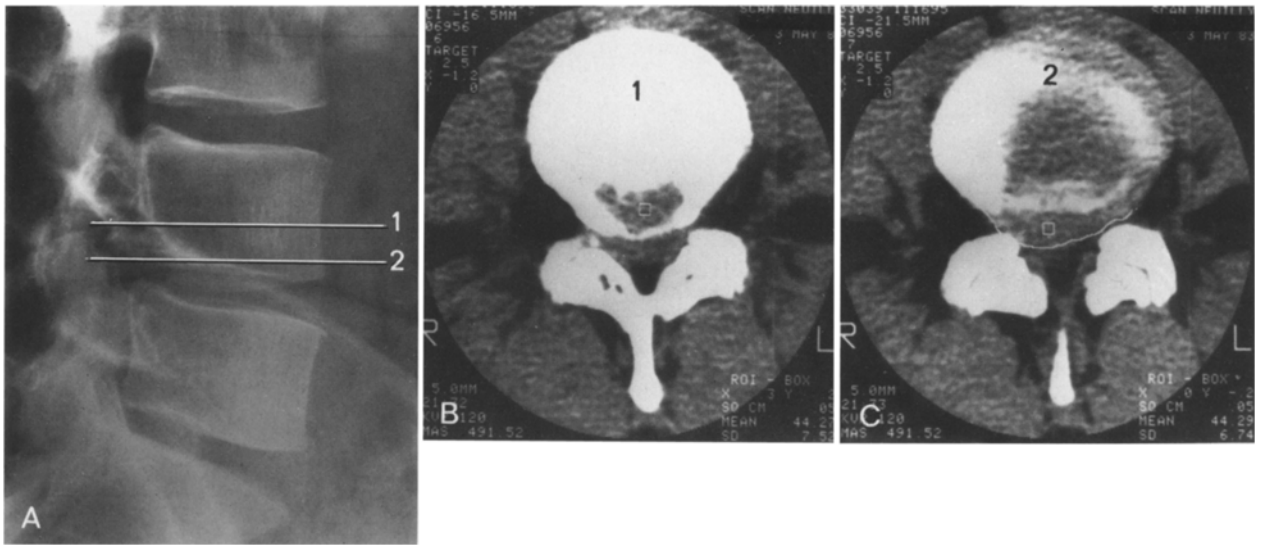

Fig. 5. *Case 8.* **A** PBA in L4 in a young man aged 28 years with bilateral sciatic pain. **B** CT demonstrates a picture of a marginal intra-osseous node at level 1 and **C** associated common postero-lateral disc herniation at level 2

Fig. 6. *Case 12.* Myelogram in a man aged 41 years with bilateral sciatic pain: anterior epidural impression with severe encroachment on the spinal canal at L4–5 level

Five patients underwent myelography (Table 1): a regular anterior epidural impression with from 50% to almost complete encroachment upon the spinal canal was found in four cases (Figs. 2 and 6). A CT scan was performed in six cases and showed a multicystic defect with a dense peripheral margin, typical of a Schmorl's node, in the middle and posterior zone of the inferior vertebral plate. Its posterior bony margin was convex and protruded into the spinal canal (Figs. 1B and 5B). Inferiorly at the disc level, CT disclosed disc herniation in three cases (Fig. 5C).

Six patients had surgery. All had posterior or posterolateral herniation of the intervertebral disc with resultant nerve root compression. In four cases, the disc herniation was associated with a bony ridge (cases 1, 2, 8, and 10). In cases 7 and 12 the surgical procedure revealed a herniated disc but no bony fragment, although the bony ridge was still obvious in postoperative radiographs. All the patients were greatly improved postoperatively. The pathological examination of curetted material showed degenerative cartilage sometimes associated with bone. In case 2, these findings were characteristic of a cartilaginous node and degenerative disc material.

Discussion

The lesions presented by the patients in this series are identical to those in previous reports [2, 4, 5, 6, 9] based on location, clinical, radiological, and surgical findings. The characteristics of the two groups of patients are compared in Table 2. Discrepancies merely concern the sex and age of patients. Ten of the 11 cases previously reported, but only four of the 12 patients in the present series were under 18 years of age. This difference reflects our exclusive selection of patients over 16 years of age.

We agree with previous reports which consider this lesion to represent an avulsion of the posterior ring apophysis. Some previous authors considered the lesion to be purely traumatic. However, several

arguments suggest that, often it may be a posterior variant of marginal cartilaginous nodes:

1. A previous history of recent trauma was found in only one of our cases (8%).
2. The radiological appearance of the lesion is not consistent with a recent fracture: on the lateral view, the limits of the vertebral defect are lobulated and surrounded by a sclerotic rim; the bony fragment protruding into the spinal canal is circular and has a dense peripheral margin. On the frontal view, the inferior margin of the vertebral body has a honeycomb appearance. The CT findings are characteristic of a cartilaginous node (Figs. 1 B and 5 B).
3. Morphologically, PBA resembles an anterior marginal node in reverse. In most cases, it differs from a "limbus vertebra", since the bony fragment is continuous with the vertebral body and acts as a posterior rim to the intraosseous disc herniation. However in some cases, the bony part appears clearly separated from the vertebral body as in a true limbus vertebra.
4. In case 3, the lesion was observed in a girl practising intensive ice-skating (Fig. 3): the avulsed bony apophysis was already identifiable at 11 years of age, but the defect of the postero-inferior margin of L4 only appeared later (at 14 years), demonstrating a progressive evolution of the lesion.
5. PBA is frequently associated with other signs of SD, namely Schmorl's nodes and marginal cartilaginous nodes. Six out of 12 cases (50%) had diagnostic signs of SD, while the reported frequency of SD in 400 unselected lateral chest X-rays is 31% for males and 21% for females [7]. Moreover, most of our patients only had radiographs of the lumbar spine so the frequency of SD is possibly underrated. In case 4 with severe SD, PBA in L4 coexisted with a similar but less pronounced abnormality of L3 (Fig. 4). Moreover, lumbar PBA resembles posterior marginal cartilaginous nodes of the thoraco-lumbar junction observed in patients with SD (Fig. 7).
6. In operated cases, the surgical findings did not suggest recent fracture, but after removal of the herniated disc and bony ridge, revealed in some cases areas of enclosed cartilaginous tissue in the vertebral body margin. These findings favour the diagnosis of Schmorl's node.
7. Finally, histological findings show the presence of hyaline cartilage and degenerative disc material in addition to the bony fragment. In case 2, histological findings are typical of a cartilaginous intraosseous node with degenerative disc material (Dr. A. Mazabraud).

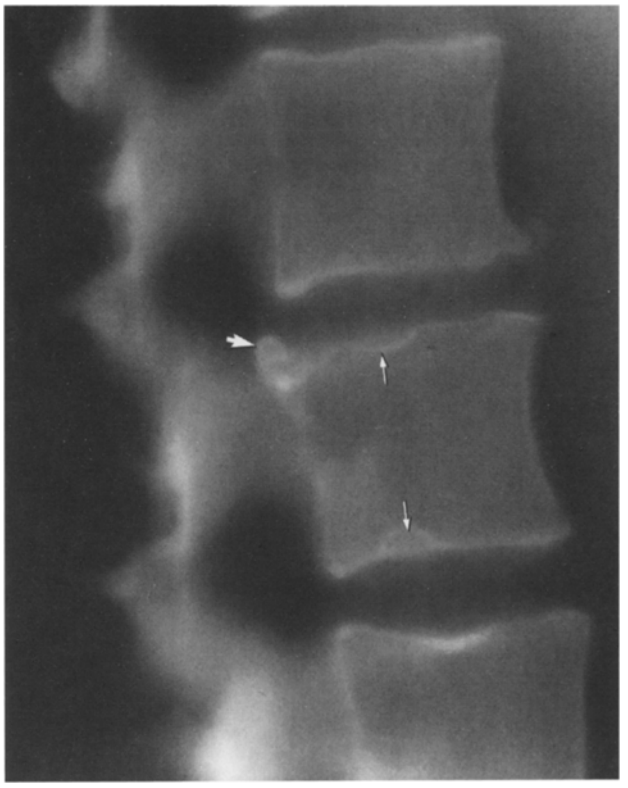

Fig. 7. Schmorl's nodes (*arrows*) and a bony ridge at the postero-superior edge of T12 (*large arrow*). This lesion probably represents a postero-superior marginal node similar to LPMN

All these arguments show that PBA is a particular type of marginal cartilaginous node and would be better called a lumbar posterior marginal node (LPMN). The mechanism of production of LPMN may be similar to an anterior marginal cartilaginous node. This is the result of a tension/shear fracture with loss of nuclear material through a split in the anulus [1]; such material prolapses between the ring apophysis and the vertebral body; limbus vertebra represents continuing ossification in the avulsed growth plate similar to that commonly seen at other sites of avulsion [1]. In a similar way, LPMN could represent ossification of a partly avulsed posterior ring apophysis.

The physiopathology of SD is still controversial; Alexander found no evidence of any underlying defect in the cartilage plate or elsewhere which would justify the concept of a constitutional abnormality, and advanced the view that SD is simply a stress dystrophy [1]. "A true histological node would be simply an end-plate fracture due to failure under dynamic load in compression or shear at a time when plate and metaphysis vulnerability is increased by rapid growth" [1]. Physiological thoracic kyphosis and lumbar lordosis could account for the anterior location of marginal nodes

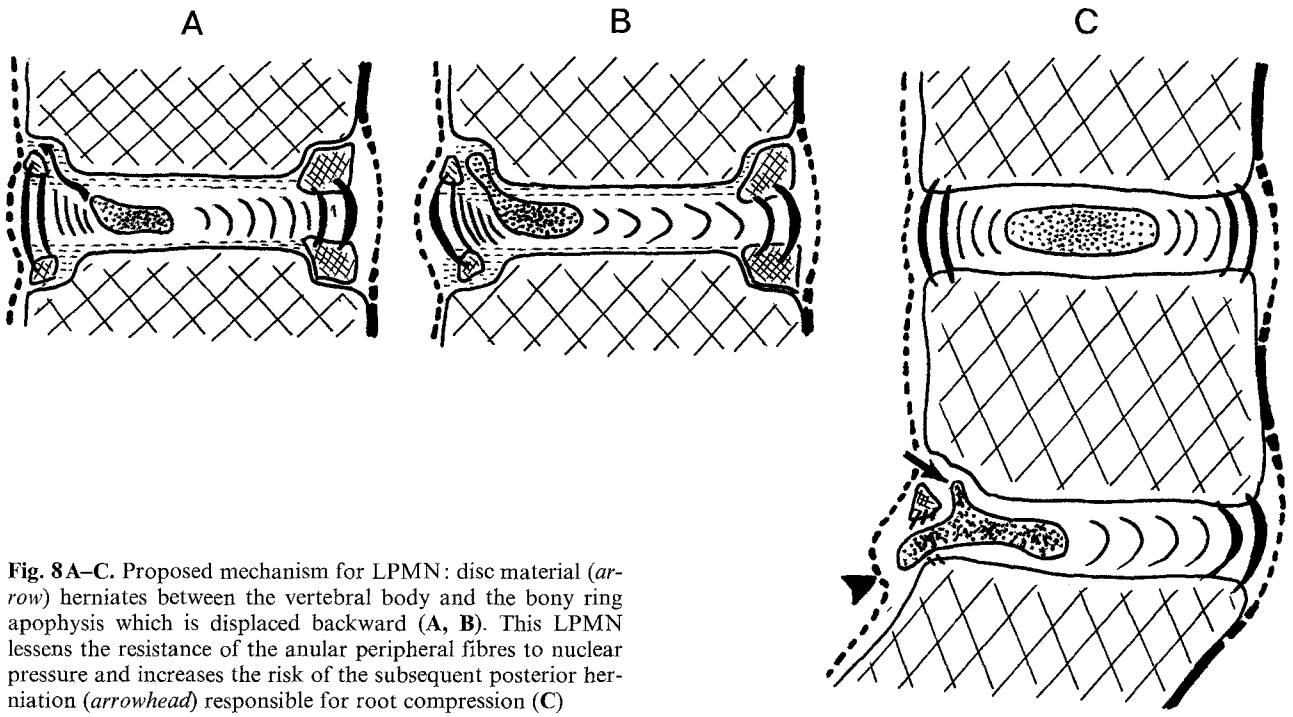

Fig. 8A–C. Proposed mechanism for LPMN: disc material (*arrow*) herniates between the vertebral body and the bony ring apophysis which is displaced backward (**A, B**). This LPMN lessens the resistance of the anular peripheral fibres to nuclear pressure and increases the risk of the subsequent posterior herniation (*arrowhead*) responsible for root compression (**C**)

in the thoracic spine and the posterior location of LPMN in the lumbar spine. Thus, marginal nodes occur in the zones of maximal pressure.

Hellstadius discussed the origin of anterior marginal nodes and limbus vertebrae [3]. He found, in most cases, special anatomical conditions such as antero-posterior widening of the vertebral plate in which the node is situated, or an abnormal anterior angle of the opposing vertebral plate. He stated that these anatomical conditions were of congenital origin and led to the formation of anterior marginal nodes. In addition, he postulated that during the daily stress of ordinary activity, namely flexion of the spine, these abnormal anatomical conditions favour the progressive impaction of disc material onto the vertebral plate, thus forming the marginal node.

In the case of LPMN, antero-posterior widening of the affected vertebral plate is present and the gradual formation of the cartilaginous node is suggested by the absence, in most cases, of a definite history of previous trauma. However, we consider that antero-posterior widening of the affected vertebral plate could also be secondary to LPMN formation.

We do not suggest this is the only explanation of PBA; it is possible that violent trauma could provoke a marginal postero-inferior fracture similar to LPMN but with other expected signs, namely a traumatic history, radiological appearances favouring a recent fracture, and lack of signs of SD.

LPMN favours the constitution of an associated conventional posterior disc herniation in the same disco-vertebral junction (Fig. 8): the resistance of posterior Sharpey's fibres to the expansive pressure of the nucleus is decreased by the lack of fusion between the bony ring apophysis and the vertebral body, particularly in the case of a strong effort such as lifting. Pressure on the anulus fibrosus is greater in young people because of the turgor present within the nucleus pulposus [8]. This may account for the young age of patients presenting with LPMN and herniated disc causing sudden nerve root compression. Symptoms usually occur after physical effort. In the most serious cases, disc herniation associated with LPMN may cause acute cauda equina compression with complete block on the myelogram [2, 9].

Symptoms are sometimes less pronounced. LPMN is usually revealed by lumbar radiographs taken because of lumbar pain with progressive onset without previous history of trauma. Associated disc herniation is often absent or minimal. However LPMN may at any time favour the onset of a posterior disc herniation at the same level resulting in sciatic pain.

Conclusion

Several arguments suggest that LPMN should be regarded as a specific posterior variety of marginal cartilaginous nodes with a frequent incidence. Fa-

miliarity with this lesion is important for several reasons: it is a major cause of herniated lumbar disc in adolescents, yet disc herniation in this age group is unusual. Three out of 14 adolescents operated on by Lowrey for lumbar disc herniation presented the lesion we call LPMN [6].

LPMN can easily be overlooked on unsatisfactory conventional X-ray examination. However, although the disorder is diagnosed from standard radiographs, it is best demonstrated by lateral tomograms and CT scan. The latter shows LPMN and any eventual associated herniated disc in the same location, which is of considerable clinical and therapeutic importance.

The radiological recognition of LPMN should lead to the investigation of other signs of SD on thoracic and lumbar spine radiographs. Once recognised, the radiological aspect of LPMN is highly specific. Ignorance of this lesion can lead to erroneous diagnoses such as vertebral chondroma (based on the histological finding of osteocartilaginous tissue in the spinal canal) [10] or infectious spondylitis in view of the decreased disc space and the irregular posterior vertebral plate.

From a therapeutic viewpoint, the discovery of LPMN on lumbar radiographs is not sufficient to warrant surgery. This decision must depend upon criteria similar to those used in simple lumbar disc herniation.

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