

*case report*

## **A calcified cervical intervertebral disc in a child and a thoracic disc calcification in an adult with posterior herniation-radiographic, computed tomography and magnetic resonance imaging findings**

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**Background.** Nucleus pulposus calcification in children is a relatively rare but well known clinical syndrome, usually localized at the level of the cervical spine. The exact aetiology still remains uncertain. Calcifications of the intervertebral discs in adults differ from the childhood variety. They are mainly degenerative in nature and occur at the level of midthoracic and upper lumbar spine. Potentially serious complications, posterior herniation of calcified disc may occur in both entities.

**Case reports.** We report two cases of the calcification of the nucleus pulposus in a seven-year-old boy at the level of C7-T1 and a case of calcified intervertebral disc T11-T12 in a forty-five-year-old woman, with massive posterior herniation. Remission of symptoms was achieved with a conservative therapy alone. Clinical, radiographic, computed tomographic and magnetic resonance imaging (MRI) findings were analyzed in an attempt to investigate similarities and differences between both disease entities.

**Conclusion.** Massive posterior herniation of calcified nucleus pulposus in a child was treated conservatively with a favourable outcome. A disappearance of symptoms followed quick resolution of herniated calcified masses. In adult variety extruded thoracic disc calcification was of a permanent type with no tendency towards spontaneous resolution and remission of symptoms after the conservative therapy. MRI seems to be able to depict disc calcification before a conventional radiography. The widening of affected discs in a paediatric patient was also better demonstrated by MRI. It would seem to support the theory of an increased intradiscal pressure as the precursor of annulus fibrosus ruptures and consecutive calcified disc herniations.

*Key words: intervertebral disc; calcinosis; intervertebral disc displacement; spinal disease - radiography, tomography; x-ray computed; magnetic resonance imaging*

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Received 3 November 2004

Accepted 18 November 2004

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### **Introduction**

Nucleus pulposus calcification in children is a relatively rare but well known clinical syndrome, usually localized at the level of the cervical spine. More than hundred and thirty cases have been reported in the literature

with an increasing number of new reports in the last decade.<sup>1-4</sup> The disease entity has been attributed to trauma,<sup>5,6</sup> inflammation,<sup>7,8</sup> or increased hydrostatic pressure within the disc,<sup>3</sup> but the exact aetiology still remains uncertain. The prognosis of discal calcifications in children is good.<sup>3,9,10</sup> As a rule pain resolves and there is a spontaneous resorption. Although the benign nature of the disease has been emphasized by many authors, the herniation of the calcified nucleus pulposus through the ruptured annulus fibrosus may occasionally occur.<sup>1,2,5,6,11-14</sup> This rare but potentially serious complication with radiologic signs of the extradural space occupying lesion raises the question of an eventual operative therapy.<sup>12-14</sup> In several cases, which have been reported in literature,<sup>1,9,11</sup> the remission of symptoms occurred with a conservative treatment.

Calcifications of the intervertebral discs in adults differ from the childhood variety and may reflect numerous systemic diseases. Disc calcifications are more frequent and often affect not only the nucleus pulposus but also the annulus fibrosus. In adults calcific deposits are mainly degenerative in nature and occur at the level of midthoracic and upper lumbar spine which are relatively nonmobile. Therefore, a posterior massive displacement of a calcified intervertebral disc into the spinal canal is a rare complication.<sup>1</sup>

Radiographic and computed tomography (CT) findings in herniated disc calcifications are well known. However, magnetic resonance imaging (MRI) appearances have not been often reported in the literature.<sup>15,16</sup> In the last decade, the significance of MRI as a primary radiologic diagnostic modality in different spinal disorders has been increasingly gaining in relevance. Therefore, the radiologists and the clinicians must be aware of the MRI findings of these rare but potentially serious complications of the intervertebral disc calcifications.

We report two cases, a case of the calcifi-

cation of the nucleus pulposus in a seven-year-old boy at the level of C7-T1 and a case of the calcified intervertebral disc T11-T12 in a forty-five-year-old woman, with the massive posterior herniation. The remission of symptoms was achieved with a conservative therapy alone. Clinical, radiographic, CT and MRI findings were analyzed in an attempt to investigate similarities and differences between both disease entities.

## Case reports

### Case I

A seven-year-old-boy presented with lower neck pain, limited movements and stiff neck, a day following gymnastic activity at school. He could not remember having had any significant trauma. There were no neurological findings. The patient was afebrile, his ery-



**Figure 1a.** Initial lateral radiograph showing calcification of the nucleus pulposus at the levels C4-C5, C5-C6, C6-C7 (arrow heads) and mild flattening of the vertebral bodies C4, C5 and C6 (arrows).

throcyte sedimentation rate and a white blood cell count were within normal limits. Initial lateral radiographs demonstrated calcifications of the nucleus pulposus at the levels C4-C5, C5-C6, C6-C7, C7-T1 and the mild flattening of the vertebral bodies C4, C5 and C6 (Figure 1a). MR imaging revealed a signal void within the intervertebral discs C4-C5, C5-C6, C6-C7 and C7-T1, findings consistent with nucleus pulposus calcifications and slight disc expansions most pronounced at the level C7-T1 (Figure 1b). Following the treatment with a cervical collar on an outpatient basis he became asymptomatic after four weeks. The patient was admitted to hospital for the second time one year later with mild left-sided torticollis. He complained of lower neck pain radiating to the shoulders. There was no history of trauma. Neurological



**Figure 1b.** Mid-sagittal PD-weighted spin echo image (TR 2200 ms, TE 20 ms) reveals signal void within the calcified intervertebral discs C4-C5, C5-C6, C6-C7 and C7-T1 (arrow heads) with slight disc expansion most pronounced at the level C6-C7. Note that the signal void at this level extends far posteriorly into the annulus fibrosus indicating the possibility of its rupture.

and laboratory investigations were normal. A control lateral radiograph of the cervical spine showed disc calcifications at the levels of C4-C5, C5-C6 and C7-T1. However, there was no nucleus pulposus calcification of C6-C7 disc which was most pronounced at the initial examination (Figure 2a). CT scan revealed minimal calcifications within the intervertebral disc C6-C7 and a narrow calcified tract in the midline leading to the rupture of the annulus fibrosus. The calcified nucleus pulposus was nearly completely herniated posteriorly and distributed quite evenly throughout the whole epidural space behind the vertebral body of T1. The narrowing of the spinal canal was slightly more pronounced on the left side (Figure 2b). On MR imaging nucleus pulposus calcifications within the disc and the epidural space were demonstrated as a signal void (Figure 2c). The signal intensity of the vertebral bodies C6 and C7 was decreased on T1-weighted images and increased on T2 weighted spin echo images, findings consistent with bone marrow oedema (Figure 2d). In comparison to radiography and CT examination MR imaging clearly revealed that there was no compression of the spinal cord. The patient was discharged from the hospital after a cervical collar was applied. On a control clinical examination six weeks later he was asymptomatic. Control CT showed only minimal remnants of the calcified herniated nucleus pulposus in the midline, the abundance of epidural masses being resorbed (Figure 3).

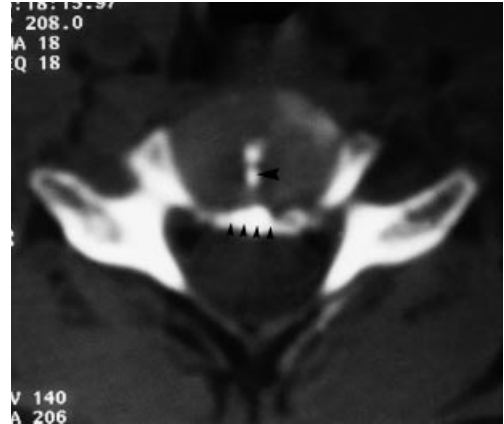
#### Case II

A forty-five-year-old female complained of pain radiating from the lower to the upper thoracic region for many years. The pain was aggravated by thoracic flexion but was not increased by coughing. There was no preceding history of any significant trauma. She experienced hypoesthetic area localized dorsally on the right side at the level of T10-T11. There



**Figure 2a.** Follow-up radiograph taken one year later shows disappearance of the nucleus pulposus calcification at the level C6-C7, which was most pronounced at the initial examination (arrow heads) and consecutive narrowing at the disc space.

was no neurological deficit and the laboratory findings were within normal limits. Lateral roentgenogram and conventional tomography of the thoracic spine showed findings typical of haemangioma of the vertebral body T10 and a calcified area in the posterior third of the intervertebral disc T11-T12. The dorsal herniation of the calcified material into the spinal canal behind the vertebral body D12 was also evident (Figure 4a). CT examination revealed the calcification of the nucleus pulposus and a narrow calcified tract leading to the rupture of the annulus fibrosus. Extruded calcified material was globular in appearance and localized in the midline within the epidural space (Figure 4b). The calcified nucleus pulposus and herniated masses were of low signal intensity on all MRI sequences.



**Figure 2b.** CT examination of the intervertebral disc C6-C7 demonstrates hyperdense narrow tract in the midsagittal plane (big arrow head) leading to the rupture of the annulus fibrosus. Herniated calcified nucleus pulposus is quite evenly distributed within the epidural space (small arrow heads)

MR imaging showed no compression of the spinal cord. The signal intensity of the neighbouring vertebral bodies T11 and T12 was normal (Figure 4c). The patient was treated with analgesics on an outpatient basis and her pain diminished in intensity but did not disappear completely. On a follow-up radiographic examination two months later the herniated calcified masses remained unchanged.

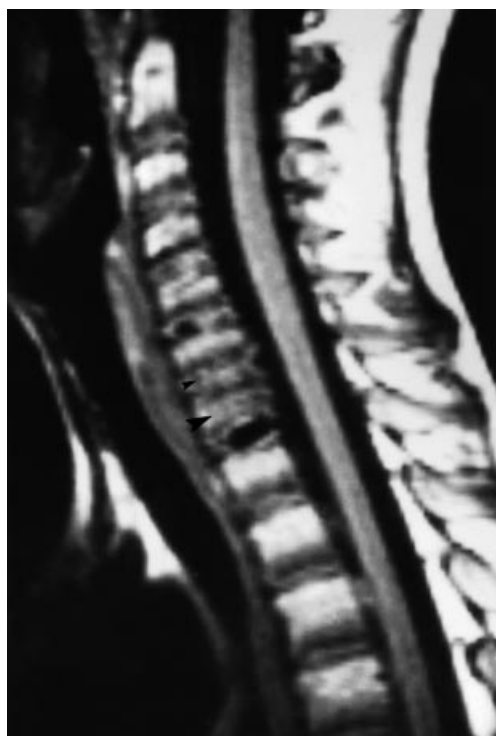
## Discussion

The herniation of the calcified nucleus pulposus in children through the rupture in the annulus fibrosus is an unusual complication. Only forty cases including ours have been published to date.<sup>1,2,5,6,11-14</sup> The calcified nucleus pulposus may be displaced in different directions. However the posterior and posterolateral extrusion into the spinal canal with the neurological signs of the spinal cord or the nerve-root compression may occasionally occur. This is the most serious complication of disc calcification in children.<sup>12-14</sup> Clinical symptoms in our patient did not dif-

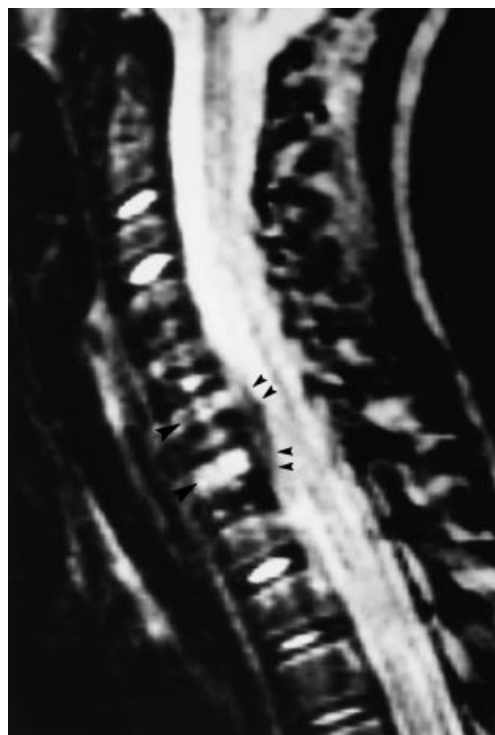
fer from similar cases reported in literature and included limited movements, stiff neck, mild torticollis and lower neck pain. There was no history of significant trauma or laboratory signs indicating the inflammation. With the exception of several patients,<sup>12-14</sup> who were treated surgically in majority of cases including ours, the remission of symptoms was achieved with a conservative therapy alone. The disappearance of symptoms in our patient coincided with a quick resolution of the herniated calcified nucleus pulposus which occurred during six weeks. Good prognosis in children may be attributed not only to a quick resolution but also to a pliability of

calcified masses which has been proved surgically.<sup>14</sup>

The calcific deposits in adults predominantly consist of hydroxyapatite and may be of impermanent or permanent type.<sup>15</sup> In our case a longstanding clinical history and a radiographic follow-up examination which showed no signs of resolution suggested the permanent type of calcification. The results of the conservative treatment in our adult patient were not favourable. Her pain did not resolve completely, which was in accordance with the radiographic signs of a persistent calcification within the spinal canal. In the absence of the significant neurological im-



**Figure 2c.** control sagittal MR T1-weighted spin echo image (TR 500 ms, TE 15 ms) reveals disappearance of sagittal void at the level of herniation (small arrow head). Extruded calcified low signal intensity nucleus pulposus cannot be identified since the CSF space is of similar low signal intensity on T1-weighted image. It is of interest to note the decreased signal intensity of the vertebral body C7 (big arrow head) consistent with bone marrow oedema.



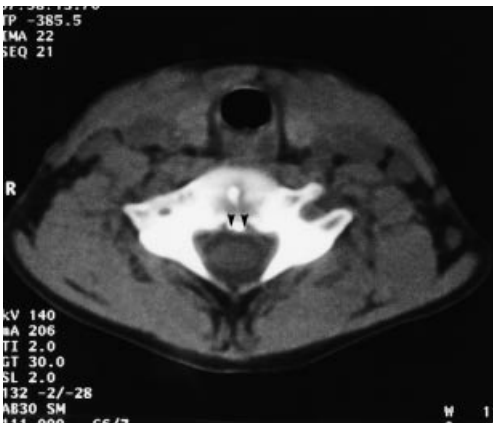
**Figure 2d.** On T2-weighted spin echo image (TR 2200 ms, TE 80 ms) high signal intensity bone marrow oedema is seen within the vertebral bodies of C6 and C7 (big arrow heads). Low signal intensity extruded calcified nucleus pulposus is clearly demonstrated due to neighbouring high signal intensity CSF on T2-weighted (small arrow heads).



pairment a surgical treatment was not justified.

Radiographic signs in our young patient were fairly typical. The usual findings of cervical multilevel disc calcifications were demonstrated. However, the distribution of calcified masses throughout the individual disc spaces differed. At the levels of C4-C5, C5-C6 and C7-T1 the calcification appeared to be flattened and more widespread. Since the normal nucleus pulposus lies eccentrically on the border between the medial and posterior third of the disc space, the widespread distribution of calcified masses suggests the intradiscal displacement of the calcified nucleus pulposus into the fissures of the annulus fibrosus, findings clearly demonstrated on CT examination. Radiographic appearances were to some extent reminiscent of discographic findings in the degenerative disc disease.<sup>17</sup> Fragmentation with a tendency towards the anterior displacement was revealed at the level C5-C6. The flattening of the vertebral bodies C4, C5 and C6 seen also in our patient, has been frequently reported in literature.<sup>3,9,10</sup>

The mechanical stress is an important factor in modeling of the normal vertebral bod-



**Figure 3.** Control CT examination done after six weeks at the level of C6-C7 reveals a nearly complete resolution with only minimal remnants of the calcified herniated nucleus pulposus within the epidural space (arrow heads).

ies. It has been proved that, in the absence of normal weight-bearing, the height of the vertebral bodies increase.<sup>18</sup> Conversely, the flattening of the vertebral bodies presumably indicates that the increased stress has been evenly distributed throughout the whole endplate reflecting the morphological appearance of widespread distribution of the calcified nucleus pulposus within the intervertebral disc. In comparison to other disc calcifications the nucleus pulposus calcification at the level of C6-C7, which ultimately herniated, was more abundant and globular in appearance. The initial MR examination (Figure 1b) revealed not only the expected signal void within the calcified intervertebral discs but also a slight disc expansion, most pronounced at the level of C6-C7, consistent with an increased intradiscal pressure, which was not so clearly demonstrated on the plain film radiography. Similar MRI findings have been already reported in discs without visible



**Figure 4a.** Conventional tomography of the lower thoracic spine demonstrates calcified nucleus pulposus of the T11-T12 disc space (big arrow heads) and dorsal extrusion of the calcified material behind the vertebral body of T12 (small arrow heads). Findings typical of cavernous haemangioma of the vertebral body T10 are also seen (arrow)

calcifications by Swischuk and Stansberry<sup>16</sup> who supposed that it could represent the initial phase of the disease entity. In our case the rupture of the annulus fibrosus occurred at the level of C6-C7 in which the disc expansion was most pronounced. These findings are in favour of the theory of an elevated intradiscal pressure.<sup>3</sup> On the basis of the MRI appearances it could be assumed that an initial phase of the disease may be characterized by an expansion of the intervertebral disc, presumably due to the osmotic absorption of water caused by an increased content of calcium salts within the nucleus pulposus. An increased intradiscal pressure makes the disc more vulnerable and ultimately leads to ruptures within the annulus fibrosus with a consecutive intradiscal displacement and/or extrusion of the calcified nucleus pulposus and disc decompression. These MR appearances also suggest that MR is probably more sensitive than radiography in depicting a disc widening and possibly that the most expanded discs are at highest risk for eventual herniations. On a follow-up radiography (Figure 2a) the disappearance of disc calcification C6-

C7 together with pain distribution suggested the possibility of the dorsal disc herniation, which has been proved on CT examination (Figure 2b).

The most common site of the calcified nucleus pulposus is at C6-C7,<sup>19</sup> which as in our case, has also been a frequent location of herniations.<sup>1,2,11</sup> It could be attributed to the increased stress at this level produced by the transition of a mobile cervical to a fixed thoracic part of the axial skeleton. The narrowing of the disc space following the herniation (Figure 2a) indicated a disc decompression. Due to its well known high sensitivity for the



**Figure 4b.** CT examination at the level of T11-T12 disc space reveals calcified nucleus pulposus and narrow hyperdense tract directed to the left para-sagittal rupture of the annulus fibrosus (small arrow heads). Extruded calcified material is globular in appearance and localized in the mid-sagittal plane of the epidural space (big arrow head).



**Figure 4c.** Sagittal MR T2-weighted spin echo image (TR 1900 ms, TE 80 ms) shows decreased signal intensity of the intervertebral discs T8-T9, T10-T11 and T11-T12 (arrow heads) and normal signal intensity of the neighbouring vertebral bodies. The extruded low signal intensity calcified masses are clearly seen against high signal intensity CSF (small arrow heads). There is no compression of the spinal cord. High signal intensity haemangioma of T10 vertebral body is also demonstrated (arrow).

demonstration of calcified structures CT is the method of choice in suspect calcified disc herniations. In our patient CT clearly showed the posteriorly and caudally extruded calcified nucleus pulposus as a hyperdense space occupying lesion evenly distributed within the epidural space. The distribution reflected operatively proved a soft toothpaste like consistence of the calcified nucleus pulposus.<sup>14</sup> One of the important advantages of MRI is its inherent high contrast resolution which enables the noninvasive presentation of the spinal cord and evaluation of the eventual compression in disc herniations. In our case a good demonstration of low signal intensity herniated calcified masses within the epidural space without a cord compression was possible only on T2-weighted images due to neighbouring high signal intensity CSF space (Figure 2d). The most interesting MRI appearances, which have not been reported previously,<sup>1,16</sup> included the low signal intensity of the vertebral body C7 on T1-weighted images and the high signal intensity of the vertebral bodies C6 and C7 on T2-weighted images, the findings which were not present at the examination done before the disc herniation. These findings, consistent with bone marrow oedema and hyperaemia, were similar to those described at the initial stage of the disc degeneration<sup>20</sup> and may presumably explain the radiographically proved early degenerative changes which occur following disc calcifications in children.<sup>10</sup> Care has to be taken not to misinterpret these MRI appearances as the presence of an infectious discitis.

In our adult patient the radiographic (Figure 4a) and CT findings (Figure 4b) were similar to changes seen in a child with disc calcification. However, there was a substantial difference in morphology of the epidural calcified masses, which were globular in the adult variety, indicating its hard consistence and nonpliability. MRI findings of the low signal intensity disc spaces at the levels of T8-T9 and T10-T11 without radiographic evi-

dence of calcifications and degeneration resembled to those seen in the case report by Swischuk and Stansberry.<sup>16</sup> It seems to indicate the high sensitivity of MRI which is able to detect disc calcifications at an earlier stage than the conventional radiography. MRI findings of the normal signal intensity of bone marrow within vertebral bodies were in accordance with the absence of significant disc degenerative changes (Figure 4c).

In summary, the massive posterior herniation of the cervical pediatric nucleus pulposus was treated conservatively with a favourable outcome. A disappearance of symptoms followed the quick resolution of herniated calcified masses. In adult variety the extruded thoracic disc calcification was of a permanent type with no tendency towards the spontaneous resolution and remission of symptoms after a conservative therapy. MRI seems to be able to depict the disc calcification before the conventional radiography.<sup>16</sup> The widening of affected discs in a child was also better demonstrated by MRI. It would seem to support the theory of an increased intradiscal pressure as the precursor of annulus fibrosus ruptures and consecutive calcified disc herniations.<sup>3</sup> The most interesting MRI findings, which have not been reported, included bone marrow changes consistent with the beginning of the disc degeneration in a child. Since these MRI appearances may resemble to early inflammatory changes, care has to be taken not to misdiagnose an infectious discitis.

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