PAEDIATRIC RHEUMATOLOGY

BACK PAIN IN CHILDREN

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SUMMARY

Pay attention to back pain reported by children. Half will have a specific or serious cause, the presenting symptoms of serious conditions may be misleadingly mild, and the spectrum of causes and mode of presentation differ from adults. Warning features include onset aged < 4 yr, symptoms persisting beyond 4 weeks, interference with function, systemic features, worsening pain, neurological features and recent onset of scoliosis. Scintigraphy is often useful where clinical features and plain radiographs fail to identify the diagnosis. Sports activities may cause stress reactions in the immature spine, particularly at the junction between spinal segments of differing mobility, the vascularity of the disc and vertebra predisposes to infection, spinal tumours presenting as pain tend to be primary and benign, congenital spinal anomalies causing pain tend to present in childhood, spondylitis presents differently from adults, and conversion hysteria, typically presenting with gross, bizarre and disabling symptoms, is not uncommon in adolescent girls.

KEY WORDS: Children, Back pain, Spondylolisthesis, Scheuermann’s disease, Discitis.

LARGE community studies report up to a half of children having experienced episodes of back pain, with the prevalence rising through the teenage years [1]. In contrast, children uncommonly seek medical help for back pain, but a specific or serious cause will be found in nearly half of these [1-4]. Serious causes may present with minor symptoms and the diagnosis is often delayed (Table I). Accordingly, follow-up is important in children where a specific cause cannot be found, and a failure of conservative treatment beyond 2 months warrants further investigation [5].

NON-SPECIFIC LOW BACK PAIN

Several studies have shown that up to half of all children in the community give a history of low back pain [1, 5-9] and the cumulative prevalence rises steadily with age: compared with the 5-9 yr olds, the prevalence is 4-fold for the 13-15 yr age group and 16-fold for the 16-20 yr age group [4]. Certain anthropomorphic variations, which may put excess strain on the spine, have been associated with back pain in children: decreased mobility of the hips; decreased lumbar extension and increased lumbar flexion; thoracic hyperkyphosis and lumbar hyperlordosis; tight hamstring muscles; poor abdominal muscle strength. Other associations are a slight preponderance of girls, sporting activities and time spent watching television [1].

TRAUMA

This must account for a large proportion of children, seen by family practitioners, with back pain that settles within a few weeks. Muscular or tendinous sprains are implicated, although on no certain knowledge, and so pain persisting after isolated or repeated trauma warrants investigation.

Submitted and accepted 19 June 1996.
In Western populations, the prevalence of isthmic abnormalities radiographically in children is reported as being 2–7% and up to 30% in elite athletes; many of these children are symptomless [10, 16–18]. In some sports [15], boys are affected twice as frequently as girls and Whites are affected more than Blacks [3].

The typical sufferer is an athletic teenage boy with an insidious onset of low back pain, usually not incapacitating, which occurs after sporting events and improves with rest. Neurological symptoms are rare. The pain is localized to the low back, just below the level of the iliac crest. There may be local tenderness, muscle spasm and, uncommonly, a major spondylolisthesis results in a palpable step or a horizontal crease across the back. Tight hamstrings are commonly found, but the cause of this is not known [3].

The best screening test is the 'one leg extension manoeuvre' [19]: when standing on one leg with the other leg and knee flexed, hyperextension of the low back evokes unilateral or symmetrical low back pain.

The principal investigations are plain radiographs of the lumbar spine and bone scintigraphy. Antero-posterior and lateral plain radiographs usually suffice, but oblique views at the L5/S1 level are indicated if a spondylolysis is still suspected. Flexion and extension views of the lumbar spine rarely show instability, and are no longer considered necessary. Increased density of the pars interarticularis or a fracture with sclerosis from a pseudoarthrosis may be seen.

Bone scintigraphy shows increased uptake by the pars interarticularis long before changes are present on the plain radiograph [20]. MRI at this stage may identify a hypo-intense area of the pars interarticularis on T1-weighted images which correlates with the scintigraphic changes [21]; the advantage of MRI is that radiation exposure is not involved.

Normal plain radiographs and scintigraphy exclude spondylolysis. Normal plain radiographs, but positive scintigraphy, are found usually within 1 yr of the onset of symptoms and indicate an attempt at healing which may be maximized by conservative treatment.

Conservative treatment may also help a lesion identified as a fracture on plain films with positive scintigraphy on the same side (i.e. an attempt at healing the fracture) or on the other side (an incipient fracture of the contralateral pars interarticularis). However, a fracture evident on the plain films with negative scintigraphy indicates non-union and also that the lesion began more than a year earlier; this may have medicolegal implications [20].

An attempt at healing, indicated by positive scintigraphy, is more likely to be successful within 1 yr of the onset of symptoms and without a spondylolisthesis. Conservative treatment is recommended in these individuals with exercises to strengthen the abdominal and paraspinal muscles, and abstinence from running, jumping, sudden changes in movement and contact sports [16] until the pain has gone and the scan is normal [14]. Even then, sport demanding extra weight bearing on extension is to be avoided. When symptoms have settled, children should be reviewed during the growing period as a spondylolisthesis may still develop. Implications for surgical fusion are a slip of > 50% or persistent back pain despite conservative measures [22].

Continuing sporting activity usually results in progression of the lesions with a poor outlook for sport [20, 22, 23].

### TABLE I

Back pain in children: clinical features suggesting causes that are serious or require specific treatment

<table>
<thead>
<tr>
<th>Feature</th>
<th>More likely to be significant</th>
<th>Unlikely to be acute post-traumatic pain</th>
<th>May be post-traumatic</th>
<th>Neurological compromise</th>
<th>Spondylolysis, spondylolisthesis, or tumour</th>
<th>Rarely 'idiopathic'</th>
<th>Less frequently idiopathic</th>
<th>Scheuermann's disease</th>
<th>Congenital anomalies</th>
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<tr>
<td>Age of onset: &lt; 4 yr</td>
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<td>Duration of symptoms: &gt; 4 weeks</td>
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<td>Interference with function, such as school, play or sport</td>
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<td>Systemic features: fever, sweats, loss of weight or appetite, malaise</td>
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<td>Pain disturbing sleep</td>
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<td>Pain worsening in severity</td>
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<td>A history of trauma or vigorous sporting activities</td>
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<td>Neurological symptoms and signs</td>
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<td>1. Gait change</td>
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<td>2. Sphincter disturbance: episodes of incontinence or change in bowel or bladder habit</td>
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<td>3. Recurrent dystonic foot or leg deformities</td>
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<td>4. Weakness: best tested functionally in the younger patient—rising from a squat, heel and toe walking</td>
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<td>Straight leg raising limited by tight hamstrings</td>
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<td>Pain below the knee</td>
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<td>Scoliosis</td>
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<td>2. Painful thoracic scoliosis to the left</td>
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<td>Exaggerated thoracic kyphosis</td>
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<td>Midline skin deformities: dimples, pigmented naevus, hairy patch, myelocoele closure scar, lipoma, dermoid cyst, dysraphism</td>
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STRESS REACTION OF THE SACROILIAC JOINTS

Two athletes aged 10 and 17 yr have been described [24] who developed low back pain with tenderness over the sacroiliac joints after starting or increasing their exercise programme. The diagnosis was not expected and was made on bone scintigraphy, which showed abnormal uptake over one or both sacroiliac joints although plain films were normal. Interpreting bone scintigraphy of the sacroiliac joints at this age range, when the epiphyses are unfused, is difficult, but the authors used both anterior and posterior views, and computer-generated images in reaching their conclusion. Complete recovery occurred.

SCHEUERMANN'S DISEASE OR JUVENILE KYPHOSIS

This is evident radiographically in 20–30% of the adult population [15], the majority of whom cannot remember any back symptoms. The usual presentation is an adolescent complaining of back pain (50%) or a painless thoracic kyphosis.

Boys present twice as frequently as girls, they usually play sports and cannot identify a specific onset, which is typically insidious. The thoracolumbar junction is the most common site, although the thoracic or lumbar spine alone may be affected; lumbar lesions are said to be more painful.

The pain is usually mild to moderate in severity, worse towards the end of the day or after physical activity, and is relieved by rest.

Examination may be normal or show an exaggerated thoracic kyphosis which is fixed in attempted hyperextension, in contrast to the 'mobile round back' [15]. A compensatory hyperlordosis and mild scoliosis are common.

Plain radiographs of the thoracic spine show an increased kyphosis with anterior wedging of one or more vertebrae, irregularity of the vertebral end plate and herniation of the disc upwards or downwards into the body of the adjacent vertebra (Schmorl's node). Similar changes are seen in any condition weakening the end plate, notably osteoporosis, hyperparathyroidism, neoplasia and disc degeneration [15]. Anteroposterior herniation under the ring apophysis may separate a fragment of the apophysis (anterior Schmorl's node) which may ossify separately—the 'limbus vertebra'. The presence of these radiographic findings is the same in the adolescent population without back pain, but MRI studies show a higher prevalence of concomitant degenerative disc changes in those with symptoms [25].

The consensus of opinion implicates trauma, repeated or acute, of the immature spine: the prevalence of these radiographic changes is greater in athletes [26, 27], especially those whose sport involves loading of the back in flexion such as gymnastics or weight lifting; post-mortem studies of vertically loaded spines show bulging of the vertebral end plate into the adjacent vertebra, causing local ischaemia of the bone, and later rupture of the disc into the body [28]. The prevalence is increased in adolescents engaged in physical labour—Scheuermann called it 'apprentice kyphosis' and another author noted that it was eight times more common in 'lads from the country' [30]. Hyperextension loads the spine anteriorly at the thoracolumbar junction [31]; in a study of symptomatic Scheuermann's disease, one-third of patients also had changes of spondylolysis [29].

The evolution of these changes has been described [27] in two gymnasts with a brief episode of pain at the thoracolumbar junction following a hyperflexion manoeuvre. Radiographs at the time showed normal disc spaces in both, but separation of the anterior fragment of the ring apophysis of T12 in one gymnast. The pain returned after a few weeks and persisted for a year or two. Repeat radiographs at this stage showed separation of an anterior fragment of the superior ring apophysis, excavation of its previous attachment to T12, and narrowing of the adjoining disc space. MRI showed extension of the disc material anteriorly. These established findings are the same as the 'anterior Schmorl's node'. Possibly recognition of the nature of the injury and abstinence from sport might have allowed healing without extrusion of disc material. Other suggested causes of Scheuermann's disease are osteonecrosis of the ring apophysis and osteochondritis.

The outlook is good. Pain decreases with restricted activity, but immobilization in plaster is occasionally needed. Bracing exercises may help. A brace is indicated in a few with a severe kyphosis [3]. A rapid and marked return of disc height after starting to wear a brace is reported [29]. Back pain in later life is more common than in controls, but is rarely severe [32].

SPINAL NEOPLASMS

Spinal neoplasms presenting as back pain in childhood are rare. Most are primary, benign, and arise from a vertebral body.

The diagnostic clues include pain waking the child at night, unremitting pain, the development of a painful scoliosis, localized tenderness, a palpable lump, bilateral sciatica, neurological signs and disproportionate anaemia. Initial plain radiographs may be normal, but scintigraphy is usually positive.

Benign vertebral tumours

Osteoid osteoma and osteoblastoma [33–35]. These are considered to be part of the same continuum. Osteoid osteoma does not exceed 1 cm in diameter radiographically, is associated with more obvious sclerosis and may have a radiolucent centre. Osteoblastoma is histologically identical, but larger. Both usually arise in the posterolateral elements, but may involve the whole vertebral body and adjacent facets and pedicles.

They present with pain in the spine, often disturbing sleep and not always giving the typical story of a response to salicylates. There may be localized tenderness and, frequently, a scoliosis. Pain radiating...
to the hip or trunk from radicular involvement occurs in half. Cervical or thoracic osteoblastomas may eventually cause cord compression.

Bone scintigraphy is more sensitive than plain radiographs, which are often initially normal. Sclerosis of the posterior elements may resemble a healing spondylolysis [36]. Excision is usually successful, but local recurrence of osteoblastoma occasionally occurs. The scoliosis may not correct if treatment is delayed for >18 months [37].

**Aneurysmal bone cysts.** One-fifth of these rare bone lesions may affect the spine, usually arising in the posterior elements and sometimes affecting several adjoining vertebrae or ribs, expanding to cause extradural pressure and a neurological deficit [38]. They usually present during adolescence, typically with pain, but sometimes with a painless scoliosis or restriction of movement. Occasionally, a swelling is palpable.

The initial radiograph may be normal. Later radiographs show a cyst bounded by a thin cortex and traversed by fine trabeculae. Scintigraphy shows increased isotope uptake. MRI identifies the degree of soft tissue spread and neural compression, and angiography demonstrates arteriovenous shunting. A needle biopsy can cause marked bleeding and is not advised when this diagnosis is suspected. Surgical excision, sometimes preceded by cryosurgery or by pre-operative embolization to reduce bleeding, is preferred to radiotherapy, which may be ineffective [38], can cause spinal growth defects, radiation myelopathy and sarcomatous change [39].

**Eosinophilic granuloma.** The most common presentation is with back pain, usually thoracic, of a few weeks duration in an adolescent. Neurological involvement is rare. Radiographs show a well-circumscribed area of osteolysis often with marked collapse of the vertebra–vertebra plana. Occasionally, several adjacent vertebrae are involved, suggesting the systemic form of histiocytosis X, of which eosinophilic granuloma is a localized form. With isolated lesions in young children, vertebral regrowth may be complete even without treatment. A neurological deficit is rare; soft tissue extension requires radiotherapy and bony impingement surgery. Chemotherapy is required for systemic histiocytosis X.

**Malignant vertebral tumours**

Ewing's sarcoma is the most common malignant tumour and can mimic spinal infection as the back pain may be accompanied by fever, leucocytosis, a raised sedimentation rate and moth-eaten bony changes on the radiographs.

Primary lymphomas may involve the spine, and non-Hodgkin's and Hodgkin's lymphoma can metastasize there.

Neuroblastoma is the most common malignancy in young children and usually presents as an abdominal mass. Spinal metastases may present with back pain. The initial haemoglobin level, often <10 g, is an important laboratory finding suggesting malignancy [40].

**Intraspinal tumours.** These are even less common. Half are extradural, spreading from adjacent vertebrae, a quarter are intramedullary, principally slow-growing astrocytomas, and a quarter extramedullary—neurofibromas, lipomas and dermoid cysts [41]. Seventy per cent are benign and slow growing with subtle progression of symptoms and signs. Forty per cent present with spinal pain which often radiates to the involved dermatomes. The remainder present with a limp or difficulty walking, changes in bladder or bowel habit, or leg or foot deformities from neuromuscular imbalance.

**DISCITIS AND VERTEBRAL OSTEOMYELITIS**

Discitis chiefly affects young children; half are aged <4 yr and it is rare after 10 yr. The presentation ranges from an otherwise well child complaining of a stiff back to a distressed, febrile child refusing to walk because of back pain [42-44]. The pain may radiate to, or only be felt in, the abdomen or thighs. The child often protects the back by sitting in a hyperextended position, using the arms as support, or by assuming an unusual posture. They are often comfortable lying down, but cry if they are made to sit.

Lesions are confined to one lumbar disc space and 80% are either L3/4 or L4/5. Bone scintigraphy is positive in all by the time of presentation, but plain radiographic changes do not appear until after 2 weeks when there is disc space narrowing and vertebral end plate irregularity.

Only one-quarter of disc aspirations are positive, usually for *Staphylococcus;* routine aspiration is not recommended by many authorities. The sedimentation and white blood cell count may be normal or moderately raised.

Recovery without antibiotics is common, but an appropriate antimicrobial agent is advised for the ill child. The outcome is good for most, but long-term studies have shown fusion of the affected vertebrae (block vertebra) [46]. The good outcome seems to reflect either the good vascular supply of the juvenile disc or infection with organisms of low virulence.

**VERTEBRAL OSTEOMYELITIS**

This affects older children and is usually caused by *Staphylococcus aureus*; spinal tuberculosis is now rare. The disc is very vascular in childhood and infection may seed there. It presents with severe back pain and muscle spasm with a marked systemic reaction. Bone scintigraphy is positive long before plain radiographs, which eventually show collapse of a vertebra or a paravertebral abscess.

A positive aspirate confirms the diagnosis. Treatment is with rest, antibiotics and surgery for neurological compromise.

The condition chronic recurrent multicentric osteomyelitis (CRMO) is a rare condition which affects adolescent children. The natural history of the disease is said to be self-limiting, but there is a good deal of
morbidity associated with it. Vertebral collapses could occur. Biopsy results are usually negative for culture. Treatment is controversial, but the case report in this section illustrates a successful treatment of this condition. The plain X-ray appearance is characteristic, and MRI and bone scintigraphy are all helpful to identify occult lesions.

**EPIDURAL ABSCESS**

This may present in children acutely or chronically with systemic features, back pain and/or neurological changes in the legs or bladder. *Staphylococcus aureus* is implicated in most. Treatment is with surgical drainage and long-term antibiotics. Irreversible neurological residua are not uncommon [45, 46].

**JUVENILE INTERVERTEBRAL DISC CALCIFICATION**

This is characterized by calcification of the nucleus pulposus which may remain symptomless or produce an acute onset of severe cervical or thoracic pain, often with a fever and an acute-phase reaction, which resolves spontaneously within weeks or months. With the onset of pain, the disc calcification starts to resorb and is complete within days to years, occasionally with disc protrusion, but rarely with neurological compromise [47].

The group of children presenting with acute pain differs from the group where disc calcification is an incidental radiographic finding: they are older (average age 7 vs 4 yr), the cervical spine is predominantly affected (thoracic spine in symptomless individuals), boys outnumber girls 1.5:1 (girls outnumber boys 2:1 in the symptomless group) and a single disc is affected (often multiple discs in the symptomless group). In contrast, disc calcification in adults is usually of the anulus fibrosis, lumbar, persistent and symptomless.

While an inflammatory response within the disc appears to trigger the symptoms and lead to resorption of the calcification, the mechanism is obscure. The acute presentation suggests infection, but is unlikely as septic discitis in children is lumbar, affects a solitary disc, and can result in disc space narrowing and a block vertebra.

A suggested mechanism is that calcification is related to developmental changes of the nucleus pulposus and an unknown trigger (trauma, infection, interference with blood supply) incites the acute inflammatory response.

**DISC HERNIATION**

Although rare, accounting for <2% of all those coming to surgery, disc herniation should be considered in the differential diagnosis of back pain in children as in two-thirds the only or the predominant complaint will be back pain without sciatica, which occurs in the remainder [48, 49].

There is a slight preponderance of boys [50, 51]. One of the lowermost two discs is nearly always affected. A familial predisposition is reported [50–52].

Some physical signs appear to be more common in children: marked postural or gait disturbance, when shuffling; restricted straight leg raising tests; weakness of plantar flexion. The plain radiograph is seldom helpful. MRI study should be interpreted with caution as a high instance of 'abnormalities' is reported in symptomless controls [53] and 'disc degeneration' is found no more frequently in this group than in controls, although disc protrusion is [54]. Although in children a large amount of nucleus pulposus tends to be extruded, sciatica is uncommon.

**SLIPPED VERTEBRAL EPIPHYSIS**

The posterior rim of the inferior epiphysis, usually the fourth lumbar, together with the adjacent disc, is displayed posteriorly into the spinal canal, analogous to a slipped femoral epiphysis. Adolescents are affected, usually boys, often after heavy lifting. The presentation is with back pain, usually without neurological impairment. Lateral radiographs may show the edge of the vertebral rim as a small bony fragment within the spinal canal and radioculography shows the disc as a large filling defect. Surgery is usually indicated [55, 56].

**ANKYLOSING SPONDYLITIS AND OTHER SPONDYLOARTHOPTHIES**

Back pain is rarely a feature of ankylosing spondylitis when it presents in children. The typical picture is a teenage boy with a remittent, asymmetrical oligoarthritis of the lower limb joints. The diagnostic clues at this stage are enthesopathies (chiefly plantar fasciitis, Achilles tendinitis, at the greater trochanter and around the patella), a family history of a spondyloarthropathy, or a personal or family history of psoriasis, inflammatory bowel disease or acute anterior uveitis.

The proportion of children with spondyloarthopathies who later develop back symptoms is disputed, with up to 80% being quoted, and of those who do the onset is usually delayed for a number of years [57, 58].

Spondylitic pain typically disturbs sleep, it is worse in the morning when it is associated with stiffness, and improves with movement. On examination, there is symmetrical restriction of lumbar spinal movements, often with residua of peripheral arthritis or extra-articular features.

Most Caucasian patients have the HLA B27 tissue type. Radiographic identification of sacroiliitis may be impossible before the age of 21, because the epiphyses, which are themselves irregular, do not fuse until about that age. However, in some studies, it is evident in three-quarters by 5 yr from the onset and in nearly all by 12 yr.

**CONVERSION Hysteria**

This is a not uncommon cause for back pain in children [59], presenting predominantly in pubescent girls. The diagnosis is often obvious with symptoms and signs that are bizarre, grossly exaggerated and inappropriate to organic pathology. Trick manoeuvres,
such as being hardly able to bend forward when standing, yet sitting up from lying without difficulty, may be elicited. There may be apparent marked spinal tenderness to light touch and diffuse tenderness along the length of the spine.

An interest in amateur dramatics should raise suspicion. Frank depression is rare and overt psychopathology often absent as the unconscious purpose is to communicate stress in coded form. The child often remains incongruously cheerful despite severe pain and incapacity, which are typically unresponsive to the usual measures. The degree of closeness between the mother and the child often appears inappropriate with the mother speaking for the child and overt non-verbal messages passing between them. The onset often follows a minor illness or injury and conversion hysteria may co-exist with organic disease, all of which can cause diagnostic confusion.

Avoid overinvestigation, which conveys to the child that you suspect you are missing a serious diagnosis. Take the problem seriously, acknowledge there is pain, do not make the child feel dismissed by insinuating there is ‘nothing wrong’ or it is psychosomatic. Manage the social handicap, such as transport to school, discuss the problem with the child and be optimistic. Look for psychological problems, liaise with non-medical colleagues such as a psychologist, along with the family practitioner and teachers.

Treatment is multi-faceted, including psychological support, avoidance of rest (which worsens the problem), and a programme of graded physical activity supervised by physiotherapists; this also provides a face-saving way to recovery.

CONGENITAL SPINAL ANOMALIES

Congenital absence of a lumbar pedicle is rare. It presents in teenagers with back pain, rotation of the lumbar spine, scoliosis and, sometimes, neurological signs. The pain appears to result from excessive mobility of the affected segment or a spondylolisthesis of the overstressed contralateral pedicle [60, 61].

Other disorders—congenital spinal fusion [42], congenital spinal stenosis [42] and widening of the spinal canal, sometimes as part of Marfan’s syndrome—may all present as spinal pain. However, the most common presentation of congenital defects of the spine is painless deformity, sometimes with a neurological defect in the lower limbs.

<table>
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<th>TABLE II Back pain in children: other disorders</th>
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<tbody>
<tr>
<td>Dysmenorrhoea</td>
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<tr>
<td>Fibromyalgia</td>
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<td>Retroperitoneal disorders</td>
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<td>Chronic recurrent multifocal osteomyelitis [62]</td>
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<td>Idiopathic juvenile osteoporosis</td>
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<td>Cystic fibrosis [63]</td>
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<td>Fibrodysplasia ossificans [64]</td>
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<td>Cushing’s disease</td>
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<td>Arachnoideitis and arachnoid diverticula</td>
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OTHER DISORDERS CAUSING BACK PAIN

These are listed in Table II.

REFERENCES
