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Original article

Adolescent spinal pain: The pediatric orthopedist's point of view

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ABSTRACT

Introduction: Ten to twenty percent of persons experience spinal pain during growth. Causes are diverse in adolescents, and it is essential to determine etiology rapidly so as to guide optimal management.
Hypothesis: It is important for the pediatric orthopedist to understand the natural history of conditions inducing spinal pain.
Material and methods: A retrospective study included 116 adolescents presenting with spinal pain at the Hôpital Nord (Marseille, France) between January 1, 2009 and January 1, 2014. Malignant tumoral etiologies were excluded. Mean patient age was 13.6 years. Risser ranged between >0 and <5. Interview and clinical examination (skin, spine, neurologic examination, general clinical examination) were systematic; depending on results, complementary examinations (imaging, biology, biopsy) were prescribed.
Results: There were 32 cases of non-specific adolescent low back pain, 31 of lumbar or thoracolumbar scoliosis, 23 of spinal growth dystrophy (Scheuermann's disease), 13 of isthmic lysis, 5 of spondylolisthesis, 8 of transitional lumbosacral hinge abnormality, 2 of discal hernia, 1 of osteoid osteoma and 1 of eosinophil granuloma. Treatment was often non-operative when diagnosis was sufficiently early. In case of failure, surgery could generally be considered.
Discussion: Correctly indicated non-operative management or surgery changes the natural history of these pathologies. The aim of treatment is to resolve pain in adolescence, as it risks becoming chronic and disabling by adulthood.
Level of evidence: IV.

1. Introduction

Ten to twenty percent of persons experience spinal pain during growth [1]. In adolescents, it is essential to determine etiology so as to guide optimal management, taking account of potential progression. The pediatric orthopedist is treating a symptom but also needs to understand the natural history of these etiologies so as to be able to change it. He or she should provide socio-occupational advice, guiding the adolescent toward an adult life free of spinal pain. Spinal pain is often a social problem.

2. Materials

A retrospective study included 116 adolescents (49 female, 67 male) presenting with spinal pain at the Hôpital Nord (Marseille, France) between January 1, 2009 and January 1, 2014. Malignant tumoral etiologies and dysraphism were excluded.

Mean age was 13.6 years (range, 11–17.5). Risser ranged between >0 and <5. Fifty-one patients were not sports players, 42 played leisure sports and 23 played competitive sports (17 footballers, 3 tennis players, 2 skiers and 1 handball player).

Seven patients had cervicothoracic pain, 40 mid-thoracic pain and 69 low back pain (58 pure lumbar and 11 L5 or S1 lumboradicular). Pain was of moderate intensity, heightened by effort. Six patients had nocturnal pain.

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3. Methods

Interview and clinical examination are systematic in case of spinal pain [2]. Depending on results, complementary examinations were prescribed. Interview determined type of pain, life-style, associated signs, age and medical history. Clinical examination screened for abnormal cutaneous signs. The spine was examined with the patient standing, frontally, dorsally and dynamically. With the patient bent forward, the finger-to-floor distance was measured. Decompensation of spinal balance and gibbosity were assessed. Spinal flexibility was assessed globally and segment by segment, following Schöber [3]. Paravertebral muscle contracture, retreat of a lumbosacral spinous process and painful points around the sacroiliac joints were screened for. Specific tests assessed muscle endurance: Sorensen-Biering test (trunk extensors), Shirado test (trunk flexors), Killy test (femoral quadriceps), and spinal extensor endurance test (lumbar and hip) [4]. Examination was completed by neurological assessment. General examination ruled out organic [5] or psychogenic [6] etiology.

Imaging comprised plain standing AP and lateral radiographs. In case of doubt as to isthmic origin, oblique views were prescribed. MRI served as screening examination in case of negative X-ray; if unavailable, scintigraphy screened for hyperfixation sites. CT served to identify bone deformity.

In case of general signs, biological examinations were prescribed. In case of persisting doubt, biopsy was performed.

4. Results

4.1. Non-specific adolescent low-back pain

Thirty-two patients had non-specific adolescent low-back pain. Pain was heightened by effort and relieved by rest. The patients included 23 leisure and 6 competitive sports players. All were managed by physiotherapy (specific posterior chain self-stretching exercises). Six were given a brace to reduce contracture. Mean rehabilitation time was 10 weeks (range, 4–30 weeks). Symptoms resolved in 21 cases, improvement was incomplete in 5 and 6 were unchanged.

4.2. Lumbar and thoracolumbar scoliosis

Thirty-one patients had a single unbalanced thoracolumbar or lumbar curve or a predominantly lumbar double curve. Pain was lumbar, relieved by rest. Nine of these patients were leisure sports players.

Eighteen were managed non-operatively, with a full-time 3-point Lyon brace for 20–30° curvature in 10 cases and part-time brace in 8 cases of <20° curvature.

Thirteen adolescents with curvature exceeding 30° underwent surgical correction on an anterolateral approach, with instrumentation of 5 (T11-L3: 7 patients) or 4 levels (T12-L3: 6 patients).

Minimum follow-up for assessment was 20 years.

4.3. Spinal growth dystrophy (SGD) or Scheuermann's disease

Twenty-three patients showed SGD. Pain was mid-thoracic, heightened by effort and relieved by rest. The patients included 5 leisure and 6 competitive sports players.

All were managed non-operatively. A cast was produced, the lumbar part being made with the patient standing in decreased lordosis and the thoracic part with the patient lying down with a support under the shoulders and included sternal and scapular supports. After 4–6 weeks, the cast was replaced by a 2-valve brace with scapular support, which was worn continuously until Risser 4 was achieved. Depending on the results, it was then abandoned during daytime and worn for at least 12 hours. Follow-up was insufficient to assess efficacy in terms of vertebral body reconstitution and disc outcome in adulthood.

4.4. Isthmic lysis and spondylolisthesis

Eighteen patients showed either isthmic lysis (13 patients) or spondylolisthesis (5 patients).

Spondylolisthesis included 2 spondyloptoses and 1 grade 3 and 2 grade 2 spondylolisthesis. All had lumbar radiculalgia. None were sports players. All were operated on with double anterior and posterior instrumentation on 2 separate approaches. Mean follow-up was 23 months (range, 16–48 months). Fusion was systematically achieved, and radiculalgia resolved in all cases; reduced low back pain persisted in 2 cases.

The 13 with isthmic lysis had low back pain and 4 had radiculalgia. There were 4 leisure and 3 competitive sports players. All were managed non-operatively, by simple brace immobilization in 9 cases or Bermuda cast in 4 cases. Four showed favorable response. Treatment lasted a mean 4 months (range, 3–6.5 months). Nine patients with residual pain underwent surgical isthmus reconstruction. Mean follow-up was 21 months (range, 16–50 months). The Buck technique was used in 3 cases [7]. Pedicular screwing with sublaminar hooks and compression of the lysis region was used in 6 cases [7]. Six patients achieved fusion.

4.5. Lumbosacral hinge transitional abnormality

Eight patients had lumbosacral hinge transitional abnormality. Pain was lumbar. Three were competitive sports players. All were managed by physiotherapy. Five wore a brace. All showed improvement, but were obliged to respect rules for lumbosacral spine locking. Three showed partial lumbarization of the first sacral vertebra and were treated surgically, with complete fusion of the first sacral vertebra. Two showed improvement. Low back pain persisted in 1 case.

4.6. Rare etiologies

4.6.1. Discal hernia (DH)

Two patients had L5-S1 DH, with S1 lumbar radiculalgia. One played leisure sport. Periradicular infiltration was ineffective; subsequent surgery consisted in simple resection of the protruding disc fragment, without disc curettage. Radiculalgia resolved, and the patients recovered a normal life.

4.6.2. Osteoid osteoma

One patient with painful thoracic scoliosis had an osteoid osteoma in the posterior arch of T6. It was treated by radiofrequency ablation.

4.6.3. Eosinophil granuloma

One patient had neck pain caused by an eosinophil granuloma in C7. The unusual nature of the pain and doubt persisting after imaging led to surgical biopsy. A Minerva brace was prescribed for 3 months.

5. Discussion

When an adolescent consults in pediatric orthopedics for spinal pain, it is important to determine etiology.

In the present study, non-specific adolescent low back pain was the main etiology, often affecting non-athletic, tall and thin adolescents at puberty. Muscle growth is slower than bone growth and contracture induces pelvic retroversion and pain [2]. Exercise and physiotherapy are sufficient. Physiotherapy and back training

play an important role. Sports organizers and coaches need to be aware of spinal health issues. In adolescents with low back pain, absence of physiological sagittal curvature, and flat back in particular, exposes the lumbosacral hinge to considerable strain, with risk of degeneration in adulthood [1].

Scoliosis of thoracolumbar origin was the second most frequent etiology. Pain is initially muscular, but the curves progress toward discal deterioration. Early diagnosis and curve management, even when angulation is less than 20°, are necessary. Non-operative care is then sufficient to neutralize the implicated lumbar site, which always shows the same natural history [8]. For >30° curves, early surgery can modify the natural history [9]. Short 4-5 level instrumentation horizontalizes the disc underlying the last instrumented vertebra, protecting the last lumbar discs against rotatory dislocation.

The third most frequent etiology was spinal growth dystrophy (SGD), caused by iterative microtrauma to the disc-epiphysis complex on vertebral bone weakened by rapid growth [10]. Murray et al. studied the natural history of this entity in adulthood, comparing subjects with and without SGD [11]; no great difference emerged, but Murray did not make a clear topographic distinction between cephalic and caudal forms. Our team identified 4 types of hyperkyphosis induced by SGD, according to the location of the dystrophic segment [12]. They can lead to discopathy in the deformed vertebral region in adulthood [13]. Surgery is indicated only in case of painful sequelae after bone maturity, and mainly concern type III (thoracolumbar) kyphosis. Before bone maturity, painful, poorly accepted or esthetically displeasing forms are managed non-operatively. Initially, physiotherapy can relieve pain [14]. In rigid forms, casts and braces are effective. The release of stress in the anterior part of the vertebral body allows harmonious vertebral growth to resume. Three studies reported results of non-operative treatment using Milwaukee braces [15,16] or the duPont kyphosis brace [17], and showed that treatment should be initiated before bone maturity and continued to term.

Isthmic lysis and spondylolisthesis were the fourth most frequent etiology. Spondylolisthesis presents very disabling lumbar radicular pain. Isthmic lysis is more common, and presents low back pain, sometimes with associated radiculalgia. Using the Marchetti and Bartolozzi classification [18], which concerns only Wiltse types I and II [19], we identified 2 forms of isthmic lysis: dysplastic and lytic. In dysplastic forms, lysis onset is early. It often induces radiculalgia. The sacrum is verticalized, with lumbosacral kyphosis [20]. Slippage is frequent [21]. Lytic forms often concern sports players and correspond to fatigue fracture [22]. Slippage is moderate. Most spondylolyses are painless and require no treatment. Painful forms are treated to prevent slippage in dysplastic forms and discal deterioration in lytic forms. The longstanding nature of the lysis is detected on MRI or CT. When detected early, non-operative management can obtain consolidation. In poorly accepted forms with late detection, treatment is surgical. There are numerous reconstruction techniques, but all involve high rates of non-union [7].

Lumbosacral hinge transitional abnormality was the fifth most frequent etiology. Castellvi's radiographic classification distinguishes 7 types [23]. The exact role of the transitional vertebra in low back pain is unclear. Farshad-Amacker reported a greater percentage of degenerate discs in vertebral segments adjacent to the transitional vertebra in adulthood [24]. In our own experience, strain related to sport heightens pain. Our treatment of choice is physiotherapy. Surgery may be needed in partial lumbarization of the first sacral vertebra, to complete fusion on the non-fused side and restore normal anatomy.

Four adolescents had spinal pain of rare etiology. Two had discal hernia. When primary, DH can be an adolescent discal disease [25]; when secondary, onset is often traumatic (posterior marginal border fracture). Takata et al. [26] described an anatomopathologic classification, refined by Epstein [27]. Treatment is initially non-operative: activity restriction, rest, anti-inflammatory drugs. In case of failure, surgery may be considered; it should be as conservative as possible, restricted to simple resection of the fragment compressing the root. Discal curettage is too damaging.

One patient had osteoid osteoma, presenting as painful scoliosis due to paravertebral muscle spasms. Pain, caused by intraosseous tension, in such cases is often nocturnal. Natural history progresses toward increasing calcification of the site, bringing resolution. Pain, however, may require treatment. Nowadays, radiologists are well able to destroy the osteoma site by radiofrequency ablation [28].

One patient had eosinophil granuloma, an abnormal proliferation of histiocytes. The first symptom of this benign lesion is pain above the affected vertebra. Biopsy is often required, as differential diagnosis is difficult. Generally, there is spontaneous resolution with partial recovery of vertebral body height. Some patients undergo surgical stabilization.

Other etiologies not found in the present series may underlie adolescent spinal pain: disc calcification (resolving if symptomatic) [29], spinal osteoblastoma [30], aneurysmal cyst [31], or infection, usually in younger children (spondylodiscitis) [32]. Spondylarthropathy often affects adolescent girls and is usually managed by pediatric rheumatologists [33]. Psychogenic spinal pain exists, but should only be diagnosed by elimination [6].

6. Conclusion

It is important for pediatric orthopedists to know the natural history of the conditions underlying spinal pain. They are often overlooked, as pain is not initially intense and is considered benign. They may, however, constitute a real public health issue in adulthood. Well-indicated non-operative or operative management can alter their natural history, and resolve adolescent spinal pain which would become chronic and disabling in adulthood.

Disclosure of interest

The authors declare that they have no conflicts of interest concerning this article.

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