

Adolescent Spondylolysis and Spondylolisthesis: The Athletic Teenager

A patient guide

In brief: In the skeletally maturing athlete, low back pain that is linked to activity is most often the expression of a stress-related lesion of the pars interarticularis, a slender bridge of bone at the back of a vertebra. What sets the adolescent picture apart from both the younger child and the adult is that this lesion is frequently an acute or early stress fracture in bone that is still capable of healing. The central clinical question in this age group is therefore one of bony healing: whether an active, recently formed lesion can be encouraged towards union, or whether it has already matured into an established defect that will not knit. This page describes the condition, its biology, the way it is investigated, and the evidence on how it behaves and is managed, with the recognition that much of that evidence is observational and uses differing measures of success.

What spondylolysis and spondylolisthesis mean

Spondylolysis describes a defect, most commonly a stress fracture, in the pars interarticularis, the narrow segment of bone connecting the upper and lower joint surfaces of a vertebra. It is found most often at the fifth lumbar vertebra, low in the spine. Spondylolisthesis describes a forward slip of one vertebra relative to the one below. The two are related but not the same. A pars defect on one side alone (a unilateral lesion) does not by itself permit a vertebra to slip, because the intact opposite side continues to tether the bone. When the lesion is present on both sides (bilateral), the bony ring is interrupted across its width and the vertebra above is free to translate forward. In adolescents most slips that do occur are low grade, meaning the degree of forward movement is modest.

Why the adolescent presentation is different

The lesion can be thought of along a timeline. In the athletic teenager, the dominant entity is an acute or early stress fracture in a pars that is still actively remodelling. Because the bone is biologically reactive, an early lesion carries a genuine possibility of healing. This is the defining feature of the age band and the reason imaging and management revolve around the activity and structural maturity of the lesion.

This contrasts with the two neighbouring presentations. In the younger child, the more prominent concerns are dysplastic anatomy, higher-grade slips and the influence of the adolescent growth spurt on progression, a picture covered on the paediatric page. At the other end, the typical adult finding is a pars lesion that healed over long ago into a chronic, established defect, sometimes called a terminal lesion, which presents not as a fresh fracture but through degenerative change, narrowing of the nerve exit foramina and the symptoms that accompany them, or through degenerative spine disease entirely, as described on the adult page. The distinction is worth stating plainly: an early active lesion in a teenager is potentially healable, whereas the chronic terminal lesion that is the usual adult finding is not.

How common it is, and the link with sport

In the general population the prevalence of spondylolysis is in the region of six per cent. Its significance rises sharply when the subject is an adolescent athlete with back pain. In a classic series of young athletes presenting with low back pain, a pars lesion was identified in close to half of cases, around forty-seven per cent, against roughly five per cent in a comparable adult group, which marks spondylolysis as a leading identifiable cause of back pain in this group rather than a rarity.

The association is strongest in sports that load the lower spine repeatedly into extension and rotation. Gymnastics, cricket fast bowling, football, dance, diving and weightlifting are among those linked with higher rates. Cricket fast bowling is a notable example, with elevated rates reported in the lumbar spine, and a recognised tendency for the lesion to appear on the side opposite the bowling arm, reflecting the asymmetric loading of the action. The common thread is repeated hyperextension, often combined with rotation, transmitted through a part of the skeleton that has not yet fully matured.

What happens over time

The long-term natural history of low-grade lesions is reassuring. Long-running follow-up studies, including the work of Fredrickson and the later cohort reported by Beutler and colleagues, found that people carrying a pars defect fared over decades much as the general population did, and that where a slip occurred its progression was slow and largely complete by early adulthood. High-grade progression was uncommon in this setting. Against that settled long-term background, the question that occupies the adolescent period itself is narrower: whether a freshly active lesion will heal with bony union or instead consolidate into an established defect. The slip itself, when present and low grade, tends not to be the source of long-term trouble.

How it presents

The characteristic complaint is back pain related to activity, often provoked by movements that arch the spine backwards, and typically eased by rest. The pain is usually felt low in the back and may be more pronounced after the sport that loads the spine. Examination has traditionally included the single-leg hyperextension test, in which the athlete stands on one leg and leans backwards, on the assumption that reproducing pain points to a pars lesion. The evidence does not support the test as a reliable means of diagnosis. Work by Masci and colleagues found that it neither confirmed nor excluded an active lesion with any dependable accuracy, so a positive or negative result on that manoeuvre carries limited diagnostic weight.

How the lesion is imaged

Imaging in this condition is used to answer two questions: is a lesion present, and if so, is it active and structurally early enough to be capable of healing. Each technique contributes a different piece of that picture, and what follows is descriptive rather than a recommendation.

Magnetic resonance imaging (MRI) is sensitive to the state of the bone marrow. Oedema, meaning fluid signal within the marrow of the pars or the adjacent pedicle, is taken as a marker of an active, biologically reactive lesion, the kind with healing potential. Its absence in an established defect points the other way.

Computed tomography (CT) shows bony anatomy in fine detail and underlies the Morita staging system, which divides defects into early, progressive and terminal according to how far the fracture line has matured and the edges have sclerosed. This structural grading speaks directly to healability, since an early lesion has intact, reactive bone edges whereas a terminal lesion has rounded, sclerotic margins.

Single-photon emission computed tomography (SPECT) reflects metabolic activity, highlighting areas where bone turnover is increased. Like the marrow oedema seen on MRI, increased uptake is read as a sign that the lesion is active rather than dormant. These modalities are complementary, each describing activity or structure from a different angle.

What the evidence says about healing and management

The likelihood of bony union is closely tied to how early and how active the lesion is, a relationship that recurs across the published series.

Using CT staging, Morita and colleagues reported union in roughly seventy-three per cent of early-stage defects, about thirty-eight and a half per cent of progressive defects, and none of the terminal defects. Sairyo and colleagues described a similar gradient, with healing in the order of eighty-seven per cent for early lesions, around thirty-two per cent for progressive lesions and none for terminal lesions, and separately found that lesions showing marrow oedema healed in about seventy-seven per cent of cases while those without oedema did not heal at all. The consistent message is that union is a realistic prospect for early, active lesions and effectively does not occur once a lesion has become terminal.

Management of the active lesion has centred on a period of restriction from the aggravating activity, with a benchmark of around three months frequently cited, alongside attention to the surrounding muscles. The role of rigid bracing has been examined directly. A meta-analysis by Klein and colleagues found clinical success, meaning resolution of symptoms and return to activity, in around eighty-four per cent of conservatively managed adolescents, and importantly found that adding a brace contributed little over activity restriction alone to that clinical outcome. A striking feature of this literature is that clinical recovery is largely uncoupled from radiographic union: many young people become and stay pain-free and return to their sport whether or not the fracture knits on imaging. Return to sport is high by both conservative and surgical routes.

Where surgery is described, it is generally reserved for lesions that remain symptomatic despite non-operative measures. Direct repair of the pars, in which the defect is cleaned and secured with hardware to encourage it to heal, has been reported to achieve union in around ninety-two per cent of patients under the age of twenty, the favourable biology of the young skeleton again being relevant. Such procedures aim to preserve the motion of the segment rather than fuse it.

Outlook

For low-grade lesions the long-term outlook is favourable, with most young athletes returning to sport. The realistic expectation of bony union belongs to early and active lesions; it is not an expectation that applies to established terminal defects, which is one of the clearest points of difference from the adult form of the condition. It is worth being candid about the evidence base: it is largely observational, drawn from cohorts that differ in how they were assembled, and it measures success in different ways, sometimes as radiographic union, sometimes as resolution of symptoms and sometimes as return to play. These endpoints do not always move together, which is why descriptions of outcome can appear to differ from one study to the next.

Common questions

What is spondylolysis?

Spondylolysis is a defect, most often a stress fracture, in the pars interarticularis, a narrow bridge of bone at the back of a vertebra. It is found most commonly at the lowest level of the lumbar spine.

What is spondylolisthesis, and how does it differ from spondylolysis?

Spondylolisthesis is a forward slip of one vertebra on the one beneath it. Spondylolysis refers to the bony defect itself. A defect can be present without any slip, and in adolescents most slips that do occur are of a low grade.

Why is spondylolysis linked with sport?

The lesion is understood as a fatigue or stress fracture caused by repeated loading of the lower spine, particularly movements that arch the back and twist it. Such loading is concentrated in certain athletic activities, which is why the condition is over-represented among young athletes.

Which sports are most associated with it?

Sports that repeatedly extend and rotate the lumbar spine feature prominently, including gymnastics, cricket fast bowling, football, dance, diving and weightlifting. The common element is repeated hyperextension transmitted through a still-maturing spine.

Why does cricket fast bowling come up so often?

Fast bowling combines extension, side-bending and rotation in an asymmetric action, and is associated with higher rates of lumbar pars lesions. The lesion is often seen on the side opposite the bowling arm, reflecting the one-sided nature of the loading.

Can the fracture heal?

In adolescents the bone is still biologically active, and an early lesion can heal with bony union. Whether this happens depends largely on how early and how active the lesion is when it is found.

What is meant by an active lesion?

An active lesion is one in which the bone is still reactive and remodelling, shown by features such as marrow oedema on MRI or increased uptake on a bone scan. These signs indicate that healing is biologically possible.

What is a terminal lesion?

A terminal lesion is an established, long-standing defect in which the bone edges have become smooth and hardened. Such lesions have lost their healing potential and do not knit, which is why distinguishing them matters.

The full set of questions and answers, with references, is available on the condition page.